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Mathematics in the *Memoirs* of the Lisbon Academy of Sciences in the 19th century

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Abstract

From the end of the 18th century until the appearance of the first issue of the *Jornal de Sciencias Mathematicas e Astronomicas* in 1877, the Lisbon Royal Academy of Sciences, founded in 1779, was the main publisher in Portugal of periodicals that included mathematical papers. In this article I will give an overview of the mathematical papers which appeared in the Academy's *Memoirs* during the 19th century, in the context of the scientific output published in its pages. We will characterize the community of mathematicians around the Academy's journal and the changes in background and in themes researched throughout the century.

Sumário

Do fim do século XVIII ao início do *Jornal de Sciencias Mathematicas e Astronomicas* em 1877, a Academia Real das Sciencias de Lisboa, fundada em 1779, é a principal entidade em Portugal que publica jornais periódicos com artigos de matemática. Neste artigo daremos um panorama do que de matemática foi incluído nas Memórias da Academia durante o século XIX, no contexto da produção científica publicada nessa época nas suas páginas. Caracterizaremos a comunidade matemática que publica neste jornal, e daremos indicações sobre as mudanças operadas quer na sua composição quer nos temas matemáticos por ela abordados ao longo do século XIX.

MSC: 01A55; 01A74

Keywords: Portuguese mathematics; 19th century; Periodicals; Lisbon Academy of Sciences

1. Introduction

The aim of this paper is to give a general overview of the mathematical papers published in the 19th century in the *Memoirs* of the Lisbon Academy of Sciences, presenting this in the general context of the scientific publications in the *Memoirs*. We will give a report on the quantitative output of the *Memoirs*, emphasizing the main subjects covered by the published papers, concentrating particularly on mathematics papers and authors.

It should be noted that there is a major restriction to our work: the Archives of the Lisbon Academy of Sciences are not cataloged and are not open to researchers. Apart from the *Memoirs* themselves, there is very little available to researchers. In particular, sometimes the only information in the individual files on the academicians is the dates when they became Academy members, and frequently there are no individual letters or any written correspondence in these files. Consequently for the time being many questions must remain unanswered, and even data such as the number of

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copies printed of each issue of the *Memoirs*, or financial questions related to the journal, cannot be answered. It may be hoped that this situation will change in the future, and it will then be possible to present an analysis of these issues and others.

We should also bear in mind not only that the subject of this paper covers a long time period but also that there is very little published on this subject, so it is inevitable that many interesting subjects related to 100 years of publication of the *Memoirs* of the Lisbon Academy of Sciences are not analyzed in depth, or even mentioned here.

In a future publication I intend to analyze the other main 19th-century Portuguese journals that included mathematics papers, particularly two further journals that the Academy of Sciences published during the 19th century, the *Annaes de Sciencias e Lettras* (1857–1858) and the *Jornal de Sciencias Mathematicas, Physicas e Naturaes* (1866–1923), and furthermore *O Instituto*, published by the academy of that name in Coimbra, and the groundbreaking *Jornal de Sciencias Mathematicas e Astronomicas*, masterminded by Francisco Gomes Teixeira (1851–1933), which radically changed the panorama of scientific journals in Portugal and initiated a new era for mathematics in this country.

2. Mathematics in Portugal in the 19th century

In 1900, the Portuguese mathematician and historian of mathematics Rodolfo Guimarães (1866–1918) published his *Les Mathématiques en Portugal au XIXe siècle* [Guimarães, 1900] as a contribution to the Portuguese section of the Paris Universal Exhibition. The main feature of this book was a 122-page catalog of 19th-century Portuguese mathematical works, compiled according to the norms of the 1889 *Congrès International de Bibliographie des Sciences Mathématiques*. This was greatly expanded, nine years later, when a second edition [Guimarães, 1909] was published under the title *Les Mathématiques en Portugal*, reflecting the change in scope of the book, which now aimed to include a comprehensive bibliography of all Portuguese mathematical works.[1] Guimarães considered three groups of mathematical works: mathematical analysis, which included algebra, analysis, probability theory, and number theory; geometry (including trigonometry); and applied mathematics, an extremely heterogeneous group that included everything that was not covered by the other two groups, namely mechanics, ballistics, astronomy, geodesy, hydrodynamics, textbooks, philosophy and history of mathematics, graphic calculus, descriptions of instruments, etc. Guimarães' information must be approached with care, due to the extreme heterogeneity of the material compiled, from research papers to textbooks. Nonetheless, from the data in this catalog, we can see that Portuguese mathematics in the 19th century can be divided into three different periods according to the average number of publications produced per year.[2] In the first half of the century very little was published on mathematics: for this period Guimarães only lists 66 works, 36 of which are in his group of applied mathematics, 18 in mathematical analysis, and 12 in geometry. In contrast to this, the second half of the century saw a blossoming of mathematics, with a rapid further increase in the last quarter of the century. There are 147 publications listed in Guimarães' compilation for the period 1851–1875, while there are 520 in the period 1876–1900. Applied mathematics is in each case the group with the largest number of publications: 83 in the former period and 221 in the latter, as opposed to 34 and 158 for mathematical analysis and 30 and 141 for geometry, respectively. The distribution over the three groups and their percentages are as listed in Table 1.

If we combine mathematical analysis and geometry, a more coherent theme-orientated group than applied mathematics, we can see that it started to dominate in the last quarter of the century, with over 57% of the total number of publications. If we only consider papers published in journals, we have a similar, although not identical, situation.

Table 1
Mathematics publications in Portugal during the 19th century, according to Guimarães

	Math. analysis		Geometry		Applied math.	
1801–1850	18	27.27%	12	18.19%	36	54.54%
1851–1875	34	23.13%	30	20.41%	83	56.46%
1876–1900	158	30.38%	141	27.11%	221	42.50%

[1] For more information on Rodolfo Guimarães and his work, see Saraiva [1993b].

[2] For a more detailed analysis of Portuguese mathematics in the 19th century, see Saraiva [2000].

Table 2
Mathematics publications in Portuguese journals during the 19th century, according to Guimarães

	Math. analysis		Geometry		Applied math.	
1801–1850	11	50.00%	1	4.55%	10	45.45%
1851–1875	18	22.78%	18	22.78%	43	54.43%
1876–1900	127	33.33%	123	32.28%	131	34.38%

Guimarães lists 22 papers in the period 1801–1850, 79 in 1851–1875, and 381 in 1876–1900 (see Table 2 for the details).

From the data in Tables 1 and 2, we can see that in the first half of the 19th century there was only a minimal output of mathematics publications. To a significant degree this was due to the successive wars that ravaged the country, added to the fact that in the 19th century the military was the dominant group among mathematicians, and so any civil unrest would affect their research work directly. In this period the Lisbon Academy of Sciences, through its *Memorias*, published the only regular scientific journal that included mathematical papers.

In the second half of the 19th century there were signs that the community of Portuguese mathematicians was slowly but surely increasing its output. For this the social stability that the country found with the Regeneration movement from 1851 onwards was essential. The role of the Lisbon Academy of Sciences was also crucial: its 1851 reform opened the way for new journals to include mathematics.[3] In the last quarter of the century, the Portuguese mathematician Francisco Gomes Teixeira (1851–1933) was of great importance, not only for his work as a mathematician, but also as the founder of the first Portuguese journal totally dedicated to mathematics.

To complete this short picture of mathematics in Portugal in the 19th century, we will draw a general outline of the places where mathematics was taught and/or researched at a higher level. During this century higher mathematics was only taught and researched in a few places in the cities of Coimbra, Lisbon, and Oporto, reflecting the small size of the Portuguese mathematics community. In Coimbra there was the university and, from 1852, *O Instituto*, an active scientific and literary academy, closely linked to the university, with its own journal, also called *O Instituto*. In Lisbon there was the Royal Academy of Sciences, which regularly published its *Memoirs*, essentially, as pointed out above, the only journal that published research mathematics up to the middle of the 19th century. Following the recommendations of its 1851 reform, the Academy started a *Bulletin*, which included the proceedings of its public sessions, and briefly—during 1857 and 1858—published the *Annaes das Sciencias e Lettras* ("Annals of Science and Arts"), which was to include memoirs that were considered worthy of publication but did not have the status of Academic Memoirs. However this last journal was not successful and lasted less than 2 years. It was not until 1866 that it was replaced by the *Jornal de Sciencias Mathematicas, Physicas e Naturaes* ("Journal of Mathematical, Physical and Natural Sciences"), which was published regularly until 1927. The other institutions in Lisbon where higher mathematics was taught were the military academies: the *Escola Naval* ("Navy School"), founded in 1845 to replace the *Academia Real dos Guarda-Marinhas* ("Royal Academy of Ensigns"); the *Escola do Exército* ("Army School"), founded in 1837 to replace the *Academia Real de Fortificação, Artilharia e Desenho* ("Royal Academy of Fortification, Artillery and Drawing"); and the *Escola Politécnica* ("Polytechnic School"), also founded in 1837, which replaced the *Academia Real de Marinha* ("Royal Academy of the Navy").[4] In Oporto there was the *Academia Politécnica do Porto* ("Oporto Polytechnic Academy"), founded in 1837 and replacing the *Academia Real de Marinha e Comércio da Cidade do Porto* ("Royal Academy of the Navy and Commerce of the City of Oporto"). There was no specific journal owned by the military for publishing mathematics papers.[5] Other journals of minor importance to mathematical matters were also published, such as the journal of the Association of the Portuguese Civil Engineers, the *Revista de Obras Públicas e Minas* ("Journal of Public Works and Mines"), founded in 1871.

[3] The statutes issued from the 1851 reform explicitly demanded the foundation of two new publications, a bulletin for the proceedings of the Academy's meetings and a journal for scientific works which could not be included in the *Memoirs* of the Academy. See Saraiva [2000, especially pp. 304–306].

[4] Initially the Polytechnic School was placed under the responsibility of the War Cabinet and was considered a military school. This was the device found to prevent the University of Coimbra from opposing its existence. The University wanted to be in total control of higher education in Portugal, and had already succeeded in blocking a previous plan to create an Institute of Physics and Mathematics in Lisbon in 1835.

[5] The *Clube Militar Naval*, an association created by Navy officers in 1866, started the *Annaes do Club Militar Naval* in Lisbon in 1871. This journal was at that time the only one with technical papers on naval problems.

From this general overview we can see that there were few places and journals where higher-level mathematics was discussed and published. One of the characteristics of 19th-century Portuguese mathematics, as pointed out above, is the important role of the military, both in research and in its dissemination. Gomes Teixeira can thus be considered a forerunner of a new period, in which it was essentially the professional civil mathematician who contributed most to mathematics in Portugal. With his work and the foundation in Coimbra in 1877 of the first journal in Portugal completely dedicated to mathematics, the *Jornal de Sciencias Mathematicas e Astronomicas* ("Journal of Mathematical and Astronomical Sciences"),[6] he helped to train a whole generation of Portuguese mathematicians.

3. The *Memoirs* of the Academy of Sciences

In this chapter I study the developments in 19th-century Portuguese mathematics on the basis of a detailed analysis of the mathematical papers published in the *Memoirs* of the Academy of Sciences from Tome I of the First Series (1797) to Tome VII Part I of the New Series (1903).[7]

3.1. The first series (1797–1839)

The first series of the *Memorias* was published between 1797 and 1839. The first tome appeared in 1797, with the title *Memoirs of the Royal Academy of Sciences of Lisbon*. It is stated on its title page that it includes papers written since the foundation of the Academy in 1779 and up to 1788.

After a dedication to the King by the Duke of Lafões (1719–1806), one of the founders of the Academy, this tome starts with an unsigned *Prologue* which functions as an introduction to the *Memoirs*. The Academy is put in the context of the times that people were then living in. It is stated that it was founded at a time when science had progressed qualitatively, when people were experiencing a unique time of discovery, and this in all layers of the Universe, both in the depths of the Earth, on its surface, and in its atmosphere, and in the faraway parts of the Cosmos, a time when the philosopher wanted not only to know the causes of properties and laws, but also "to measure and number their quantity."[8] The founding of "literary corporations" is one of the most efficient means to increase all kinds of knowledge, and this is highlighted as the main reason for the establishment of the Academy, together with the patriotic duty of contributing to the development of Portugal. It is stated that this country, by the size of its territories, and the extent of its colonies, is a good field for the research of the naturalist, the chemist, and the anatomist. And it is stated that "this required the progress of all fields in mathematics, which will lead to perfecting the art of navigation, one of the main pillars of the nation's strength and wealth."[9] The *Prologue* ends by mentioning that the publication of the *Memoirs* of the Academy aims not only to make known the work of its members but also to promote public utility, "the purpose of the Academy."[10]

Tome II, which came out in 1799, was described as the continuation of the 1797 tome. It changed its name to *Memoirs of Mathematics and Physics of the Royal Academy of Sciences of Lisbon*, as the Academy had decided to have separate publications for literary memoirs and for memoirs on economics, a name that was maintained in the two parts of Tome III, published in 1812 and 1814. So we see that there is a 13-year gap between the publication of Tome II and Part I of Tome III. Part of the explanation for this delay is to be found in the wars in which Portugal

[6] On the beginnings of this journal, see Saraiva [2005, 170–175]. For data on Portuguese mathematical journals in the 20th century, see Rodrigues [2004].

[7] In 1936 the Lisbon Academy of Sciences published in Tome I of its *Memoirs*, Class of Sciences, an index to its previous publications, including the *Memoirs* and the *Jornal de Sciencias Mathematicas, Physicas e Naturaes*. Its title, "General index of works that concern the Class of Sciences and that can be found in previous publications" (*Índice geral das memórias e trabalhos que interessam à Classe de Ciências e se encontram nas publicações anteriores*), calls attention simultaneously to its scope and its limitations: it is not a complete index. But what is unexpected is the poor quality of the work, full of mistakes, in a text that should be free from them. It omits some works concerning the Class of Sciences, in particular some mathematics papers; it presents incorrect titles of papers; sometimes it omits their authors, at other times it changes their names; the page numbers of the papers are not all correct. So this index, which could have been really useful if well done, should be approached with extreme care and has only been of limited utility for the present research.

[8] "medir e numerar a sua quantidade."

[9] "A sua feliz situação está requerendo o adiantamento de todos os ramos da Mathematica, que conduzem a aperfeiçoar a arte da Navegação, hum dos principaes esteios da força, e da riqueza Nacional."

[10] "objecto da Instituição da Academia."

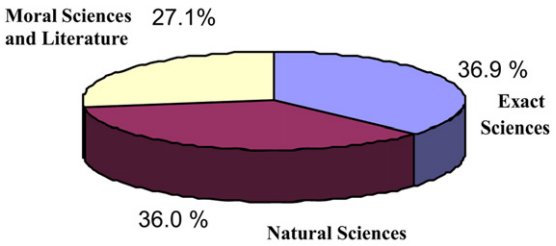

Fig. 1. Percentage by class in the First Series of the *Memoirs*.

was engaged: first in 1801 a short but disastrous war against Spain, then in the period 1807–1811 the country was invaded by Napoleon's armies. From Tome IV onwards, the title of the *Memoirs* was changed to *History and Memoirs of the Royal Academy of Sciences of Lisbon*. From 1812 to 1823 we have about one publication per year. Except for Tome VII, which is a single volume, all tomes from Tome III to Tome VIII are in two parts, and so in the period 1812–1823 there were 11 volumes published. From then onwards, with a difficult background of public unrest and civil war, publication became less frequent; in the 16 years of the 1824–1839 period, only 7 volumes were published, corresponding to Tomes IX to XII. All except one of these (Tome IX) were published in two parts.

Overall, in the 42 years of the first series, 12 tomes were published, 8 of them in 2 volumes, that is, a total of 20 volumes in 42 years, less than one volume every two years.[11] In these 20 volumes there are 211 papers, which are distributed as shown in Fig. 1: 78 in *Exact Sciences* (36.9%), 76 in *Natural Sciences* (36%), and 57 in *Moral Sciences and Literature* (27.1%).[12]

The first group includes 2 papers on military engineering, 7 on physics, 35 on astronomical observations, and 34 papers related to mathematics, 6 of which are on the history of mathematics (one being a *Eulogy* of D'Alembert, the other five on the history of navigation). In the *Natural Sciences* group we have mainly papers on zoology, botany, geology, meteorology, chemistry, and medicine. In the *Moral Sciences and Literature* group we have mainly papers on literature, geography, and history, and also some papers on linguistics and law.

Of the 211 papers published between 1797 and 1839, 54 were included in the first two tomes (24 + 30). This relatively large number can be explained by the fact that their publication covers the period starting with the foundation of the Academy at the end of 1779. Also, we have 35 papers in the two parts of Tome III (17 + 18). Again we should bear in mind that there were no tomes published between 1799 and 1812, so these two volumes in fact include papers written over a 15-year period. From Tome IV onwards the number of papers per volume is mostly between 5 and 9 (this is the case in 12 of the remaining 16 volumes). That is, there is a steep decrease in the number of papers published per volume from 1815 onwards: 42.2% of the papers appear in the first 4 volumes, covering a 17-year period (in fact 35 years if we count from the foundation of the Academy), and 57.8% in the 16 volumes published between 1815 and 1839, a 25-year period. Thus, although there is a very sharp contrast in the number of papers published per volume in the periods 1797–1814 and 1815–1839, the contrast almost vanishes if we compute the number of papers published per year: between 1797 and 1814 we have 5.2 papers per year (but this figure decreases to 2.8 per year if we consider instead that these publications correspond to the period 1780–1814), while there are an average of 4.9 papers per year in the second period, with the overall average for the 42 years of the first series being 5 papers per year.

The real differences between the two periods can be found in the subjects of the papers published: 20 of the 28 mathematics papers published in the first series relate to the 1797–1814 period; similarly in this period we find 26 of the total of 35 astronomical observations, 5 of the 7 physics papers, 11 of the 13 papers on meteorology, 9 of the 11 papers on botany (this is an exception among papers in natural sciences; for instance, in this period only 2 of the

[11] The years of publication of the volumes in the first series are as follows: Tome I: 1797; Tome II: 1799; Tome III, Part I: 1812; Tome III, Part II: 1814; Tome IV, Part I: 1815; Tome IV, Part II: 1816; Tome V, Part I: 1817; Tome V, Part II: 1818; Tome VI, Part I: 1819; Tome VI, Part II: 1820; Tome VII: 1821; Tome VIII, Parts I and II: 1823; Tome IX: 1825; Tome X, Part I: 1827, Tome X, Part II: 1830; Tome XI, Part I: 1831; Tome XI, Part II: 1835; Tome XII, Part I: 1837; Tome XII, Part II: 1839.

[12] We consider the distribution according to the then existing classes of the Academy, with the names they were given in the 1834 reorganization. With the 1851 reform the number of classes was reduced to 2. Besides the papers published, we also include the seven historical eulogies contained in these *Memoirs*. We do not consider other items, such as speeches or yearly accounts of the work done in the Academy or in any specific field.

10 geology papers of the first series were published). From Part I of Tome VI (1819) onwards we have all the papers on law published in the first series, 21 of the 24 history papers, and all the literature papers. That is, considering the subject areas of papers published in the *Memoirs*, there is a clear shift from the exact sciences to the social sciences and literature, a clear indication that the impact of the 1772 reform of the University on the Portuguese scientific community was vanishing.

The authors of the 28 mathematics papers are[13]

1. Mateus Valente do Couto (1770–1848)—5 papers (4 + 1)
2. Francisco de Borja Garção Stockler (1759–1829)—4 papers (4 + 0)
3. Francisco Simões Margiochi (1774–1838)—4 papers (3 + 1)
4. José Monteiro da Rocha (1734–1819)—3 papers (3 + 0)
5. José Maria Dantas Pereira (1772–1836)—2 papers (1 + 1)
6. João Evangelista Torriani (1770–1821)—2 papers (1 + 1)
7. Francisco da Paula Travassos (1764–1833)—2 papers (2 + 0)
8. José Cordeiro Feio (1787–1884)—2 papers (0 + 2)
9. Manuel Joaquim Coelho da Maia (1750–1817[14])—1 paper (1 + 0)
10. Marie Charles Théodore de Damoiseau de Montfort (1768–1846)—1 paper (1 + 0)
11. Manuel Pedro de Mello (1765–1833)—1 paper (0 + 1)
12. Francisco António Ciera (1763–1814)—1 paper (0 + 1)

The themes of these papers are arithmetic, algebra, and series theory (9), differential and integral calculus (6), mechanics (3), astronomy (3), symbolic calculus and problems of foundations of mathematics (3), plane and spherical trigonometry (2), probability theory (1), and combinatorics (1).

It is striking how few people published papers on mathematics in the *Memoirs*: only 12 over a 42-year period. We have 9 authors for the 20 papers published in the first period, and 7 authors for the 8 papers published in the second period, which illustrates one difference between these two groups of mathematicians: while there was some continuity of publication in the first group (4 of the 9 researchers published 14 papers during this period[15]), there is none in the second group (only one researcher in this group published a second paper). There is also a significant difference concerning the themes analyzed: there are no papers on integral and differential calculus in the second period; the eight papers published in this period are on the following themes: algebra (3), combinatorics, probability, astronomy, and spherical trigonometry (2), while of the 20 papers in the first period, 6 are on differential and integral calculus, 3 on mechanics, 2 on astronomy, 8 on algebra, and 1 on plane and spherical trigonometry. All the authors except one are Portuguese and write in Portuguese. The exception is the Frenchman Marie Charles Théodore de Damoiseau de Monfort, Captain-Lieutenant of the Royal Navy Brigade, who worked for a time in the Observatory of the Royal Academy of the Navy. He was elected a member of the Lisbon Academy of Sciences in 1806.[16] In Tome III, Part I, he published an astronomy paper in French, *Memoire sur les variations des elémens elliptiques de Pallas et de Ceres*.[17]

[13] The numbers in brackets are the number of papers published in the periods 1797–1814 and 1815–1839, respectively.

[14] A usually reliable source [da Silva, 1858–1870] gives 1847 as the year of Coelho da Maia's death. Among other sources, we checked Coelho da Maia's file in the Lisbon Academy of Sciences, and it is stated that he died in 1817. In fact in Tome V, Part II of the First Series of the *Memoirs*, we can read the vice-secretary's speech at the Public Session of June 24, 1817, in which he states that Coelho da Maia died "recently" (p. 14).

[15] Two scholars are clearly the guiding force in the mathematics in Tomes I and II: in Tome I, Monteiro da Rocha, the main architect of the 1772 University reform, and Garção Stockler, then Secretary of the Academy, have two papers each; in Tome II they have respectively one and three papers, that is, they author eight of the eleven mathematics papers that are included in these two tomes. In 1812, when Part I of Tome III was published, neither Monteiro da Rocha nor Stockler had any papers in it: Monteiro was then 78 years old and Stockler had since 1807 been at odds with the Academy and the King, a conflict which was only settled when he arrived in Rio de Janeiro in 1812, where he stayed until 1820. For more details on this and on Stockler, see Saraiva [1993a].

[16] His file at the Lisbon Academy of Sciences states that he attended the Academy's sessions from March 20, 1804 onwards.

[17] It is interesting to note that in Tome III, Part I, which was published after a hiatus of 13 years, this is the only mathematics paper. The following volume, published two years later, includes nine mathematics papers written by four Portuguese mathematicians, including four by Mateus Valente do Couto and three by Francisco Simões Margiochi. It is reasonable to suppose that some of these papers were completed before 1812.

During his stay in Portugal he published a further two memoirs on astronomical observations.[18] He returned to France with Junot in 1808, that is, before the publication of his paper in the *Memoirs* of the Academy.[19]

As for papers on the history of mathematics (with one exception, all related to navigation problems), we have

1. António Ribeiro dos Santos (1745–1818)—3 papers (0 + 3)
2. Joaquim José da Costa de Macedo (1777–1867)—2 papers (0 + 2)
3. Francisco de Borja Garção Stockler—1 paper (a historical eulogy of D'Alembert) (1 + 0)

Only very few papers on this subject were published in the *Memoirs*; Stockler has his in Tome I, Ribeiro dos Santos has his 3 papers in Tome V, Part I, one year before his death, and Costa Macedo's two papers are separated by 16 years, the first appearing in Tome VI, Part I (1819), and the second in Tome XI, Part II (1835).[20]

If we analyze the above-mentioned authors of mathematics papers by age, we can see that Monteiro da Rocha, Ribeiro dos Santos and Coelho da Maia stand apart: they were 63, 52, and 47 years old, respectively, when the first volume of the *Memoirs* was published; then we have a generation of four mathematicians who were between 32 and 38 years old when Tome I was published: Stockler, Ciera, Paula Travassos, and Pedro de Mello; and a second generation of six scholars, who were between 20 and 29 in 1797: Damoiseau de Monfort, Torriani, Valente do Couto, Dantas Pereira, Simões Margiochi and Costa Macedo. Only one other mathematician wrote in the first series of the *Memoirs*, Cordeiro Feio, who was only 10 years old when Tome I was published, and is therefore the youngest of the group of mathematicians who wrote in this Series.[21] It is a sign of the aging of the mathematics writers in the *Memoirs* that when the last volume of the first series was published 9 of these 14 scholars were dead, the youngest of the five survivors was 52 years old, and the oldest 71 years old.

Although the biographical data we have for these 14 scholars are in many places sketchy, we can already get a clear picture of their general background and activities: typically, a contributor to the *Memoirs* in this period would have studied at the University of Coimbra, most probably at its Faculty of Mathematics, and would be a professional soldier, possibly at some time a Member of Parliament, who would have taught at one of the military academies or at Coimbra University. More specifically, in this group of 14 people we have 11 who studied at Coimbra University, 9 of them at its Faculty of Mathematics; 8 were professional soldiers, 7 were either members of Parliament or were otherwise involved in politics, and 12 taught either at the University or at the Military Academies. From existing records, which are by no means complete, we know that 4 taught at the Faculty of Mathematics of Coimbra University, 9 were teachers at the Navy Royal Academy, 2 taught at the Royal Academy of Ensigns, and one (the youngest, José Cordeiro Feio), had a teaching position at the Polytechnic School.

[18] *Memoire sur le Comète de 1807* was also included in Tome III, Part I. Damoiseau de Monfort had another *memoire* published in 1801, on the solar eclipses observed in Lisbon. On the biographies of Portuguese mathematicians or mathematicians that lived in Portugal for some time we generally use the information in Balbi [1822], da Silva [1858–1870] and in the *Grande Enciclopédia Portuguesa e Brasileira*, Lisbon, Editorial Enciclopédia.

[19] Damoiseau continued his research in France and achieved a certain fame in astronomy, with long papers on lunar theory and perturbation. In 1818 he won a competition set by the Turin Academy with a paper on the return of Halley's comet; then in 1820 he shared with F. Carlini a prize on lunar theory set by the *Académie des Sciences de Paris*. He published *Tables de la lune, formées par la seule théorie de l'attraction et suivant la division de la circonférence en 400 degrés*, Paris, Bachelier, 1824, and *Table ecliptique des satellites de Jupiter d'après la théorie de leurs attractions mutuelles et les constantes déduites des observations*, Paris 1836. He was elected a member of the *Académie* in 1825. In the same year he became an *adjoint* in the *Bureau des Longitudes*. On Damoiseau in the context of French mathematics see Grattan-Guinness [1990, especially pp. 1200–1204].

[20] The 34 mathematics papers of the First Series (including the six papers on the history of mathematics) occupy 928 pages, an average of 27.3 pages per paper. Twenty-eight of these papers are less than 40 pages long, with 16 up to 20 pages, and 12 between 21 and 40 pages. Four papers are between 41 and 60 pages. The two longest papers are written by the two most influential Portuguese mathematicians of the beginning of the 19th century, Stockler (100 pages) and Monteiro da Rocha (78 pages). Four authors (the two just mentioned, plus Valente do Couto and Simões Margiochi) wrote half of the papers, with a total of 582 pages, 62.7% of the total number of pages of the mathematical papers of the First Series.

[21] He had his first paper in Tome X, Part II when he was 43 years old, and the second seven years later, in Tome XII, Part I.

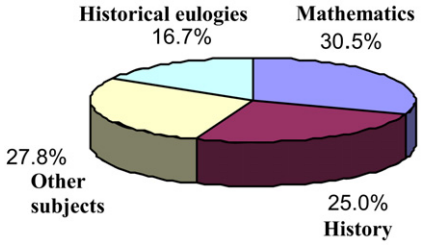

Fig. 2. Subjects covered in the Second Series of the *Memoirs*.

3.2. The second series (1843–1856)

There were three Tomes published in this period, each in two parts: hence we have six volumes published in 13 years, that is, an average of about one volume every two years.[22] The first volume (1843) has 9 papers, while all the others have between 3 and 8 papers each. A total of 36 papers were published during the 13 years that this series lasted, including six historical eulogies,[23] so compared to the first series there is a decrease in the average number of papers published per year to about 2.8. There is also a decrease if we consider the average number of papers per volume in this period: 6, much less than the 10.5 papers per volume for the first series. There are 11 papers on mathematics (we include here one paper on the history of navigation) and 9 on history. The other 10 papers are on subjects such as military engineering, history of science, chemistry, mineralogy, medicine, geography and literature, with only one or two papers per subject (see Fig. 2).

There are no foreign contributors in the second series and all the papers are in Portuguese. Mathematics is the only regular feature in this series, with at least one paper in each issue.[24] However, again we have a very small group of authors; this time four academicians are the authors of the 11 papers:

1. Mateus Valente do Couto, 2 papers, on astronomy and navigation;
2. Joaquim José da Costa de Macedo, 1 paper on history of navigation;
3. Filipe Folque (1800–1874), with one long paper on geodesy published in six parts;
4. Daniel Augusto da Silva (1814–1878), 2 papers on mechanics.

Of these scholars, Valente do Couto and Costa Macedo had papers published in the first series of the *Memoirs* of the Academy.[25] It is worth noting the papers by Daniel da Silva (in Parts I and II of Tome III), one of the two most important Portuguese mathematicians of the 19th century, the other being Francisco Gomes Teixeira. Also we note the scarceness of mathematics papers in this period: as in the first series, there is less than one paper published per year, and there are no papers on the history of mathematics in this series.[26]

[22] The years of publication of the volumes in the second series are as follows: Tome I, Part I: 1843; Tome I, Part II: 1844; Tome II, Part I: 1848; Tome II, Part II: 1850; Tome III, Part I: 1851; Tome III, Part II: 1856.

[23] In contrast to the first series, in which the seven published historical eulogies were written by six different authors, in the second series Manuel José Maria da Costa e Sá (1791–1843), who had already written two eulogies in the first series—in Tome V, Part II (1818) and in Tome IX (1825)—was the author of five of the six eulogies, which were read at the Academy's public sessions in 1824, 1829, 1830, 1838, and 1843. Therefore we can see that they were published in the *Memoirs* only much later; for three of the five papers the delays were between 18 and 20 years! In fact all five eulogies published in the second series appeared after da Costa's own death. The only other eulogy published in the second series was by Francisco Inácio dos Santos Cruz (1787–1859), in Tome III, Part I (1851). Of all these eulogies, the only one on a mathematician was that written by Stockler on D'Alembert in Tome I of the first series.

[24] We count Filipe Folque's long paper, published in six parts (in five of the six volumes of this series), as six papers.

[25] In the year of publication of the last volume of the first series, the other two authors, Filipe Folque and Daniel da Silva, were 39 and 25 years old, respectively.

[26] The 11 mathematics papers of the Second Series occupy 1642 pages, of which 886 are taken by tables belonging to the six papers by Filipe Folque on geodesy. Not counting these tables, the 756 pages of these 11 papers give an average of 68.7 pages per paper. The two longest papers (again not counting the pages with tables) are by Costa de Macedo (232 pages) and Daniel da Silva (171 pages). The 6 papers by Folque total a massive 1187 pages. Four papers (one by Folque, the two by Valente do Couto, and one by da Silva) are less than 20 pages long each.

It is striking that there was such a wide age range between these four scholars: when the first issue was published, they were respectively 73, 66, 43, and 29 years old. From what is known about them, their general profile is similar to that sketched for the contributors to the first series: three studied at Coimbra's Faculty of Mathematics, and one was also a student at both the Royal Academy of the Navy and the Royal Academy of Ensigns. Professional soldiers were still the main group, with three out of four, while only one of them was a Member of Parliament. Regarding teaching, two were at the Royal Academy of the Navy, one at the Royal Academy of Ensigns, and of the newly founded schools, one taught at the Navy School and another at the Polytechnic School.

In this series several issues include the yearly research program of the Academy. In the first issue of the second series, Tome I, Part I (1843) the program for 1842 is printed, but none of the mathematics papers published in this series (which lasted 13 years) is on any of the subjects mentioned in that program.[27]

3.3. The new series (1854–1903+)

For this overview of the Academy's *Memoirs* in the 19th century, the last volume we consider is Part I of Tome VII. Although it was published in 1903, it seemed more appropriate to consider it the last volume of the 19th century than Part II of Tome VI, which was published in 1887, 13 years before the end of the century.[28]

We see that the first 13 volumes of the new series are published over a 49-year period, that is, less than 1 volume every 3 years. In these 13 volumes there were 87 papers, a small increase in papers per volume compared to the second series (6.7 instead of 6) but in reality a large decrease if we consider that this increase is due to the small number of volumes published. If we consider the number of papers published per year in this period it comes down to 1.8, the lowest for the three series considered in the *Memoirs*. This echoes the fact that the *Memoirs*, the leading scientific journal in Portugal, was no longer unique in the second half of the 19th century. First Coimbra's *O Instituto* started publication in 1852, then the Academy's own *Jornal de Sciencias e Lettras* (1857–1858) and the *Jornal de Sciencias Mathematicas, Physicas e Naturaes* (1866–1927), and from 1877 onwards the groundbreaking *Jornal de Ciencias Mathematicas e Astronomicas*.

Medicine and natural sciences were the dominant subjects in these first 50 years of the new series: 30 papers were published on medicine, there were 35 papers on natural sciences (including botany, zoology, geology, and mineralogy), and mathematics comes third, with 11 papers. That is to say, these three subjects account for 87.3% of all the papers published. The other 11 papers were on chemistry, physics, hydraulics, agriculture, and history (see Fig. 3).

In this new series up to Part I of Tome VII, all papers except seven are in Portuguese. These seven papers were written by seven different authors, of whom only one was Portuguese: Felix António de Brito Capelo (1828–1879), who wrote a paper in French on a zoological theme in Part II of Tome V (1878). The other six authors have papers on geology (Part I of Tome II), physics (Part II of Tome II), zoology (Part II of Tome III), medicine (Part II of Tome IV), and two on mathematics (one in Tome VI, Part II, the other in Part I of Tome VII).

The significant lessening of the importance of mathematics research in the context of the Academy can be confirmed in the very first volume of the new series, in which the research program for 1855, 1856, and 1857 is published. These contain nothing on mathematics, only on physical sciences, natural history, and medicine (1855), on natural sciences (1856), and on medical sciences (1857).

The authors of the mathematics papers in this series are

[27] For the Exact Sciences, the 1842 program reads: "in Calculus: to prove completely the method of the minimum squares conceived by Legendre, to compute the constant coefficients of the equations that represent the laws of phenomena; to prove using analysis the main theorems of Geometry; in Mechanics: to simplify the mechanism of the steamships, avoiding the shortcomings of the paddle-wheel, and its high fuel consumption; in Astronomy: description of the means of computing, in a simple and rigorous way, the principle of the moon's eclipses; in Military Engineering: to write down the plans for the defence of the port of Lisbon, making the city safe from any sea attack."

[28] The years of publication of the other volumes of this series up to 1887 are Tome I, Part I: 1854; Tome I, Part II: 1855; Tome II, Part I: 1857; Tome II, Part II: 1861; Tome III, Part I: 1863; Tome III, Part II: 1865; Tome IV, Part I: 1867; Tome IV, Part II: 1870; Tome V, Part I: 1875; Tome V, Part II: 1878; Tome VI, Part I: 1881. The new series had a final volume, Tome VII, Part II, published in 1914. This last volume contains six papers, four of which are on mathematical themes: one paper on the history of mathematics, one paper on mathematics applied to engineering and hydraulics, and two papers on astronomy. In spite of the fact that there was a 14-year gap between this volume and the previous one, this suggests a revival of interest in mathematical subjects. This volume also marks the first paper in the *Memoirs* by Rodolfo Guimarães, the main historian of Portuguese mathematics in the early 20th century. After Tome VII, Part II there was a 22-year hiatus, due to lack of money. The *Memoirs* resumed publication in 1936, with two different series, with the papers of the Class of Sciences having their own separate series.

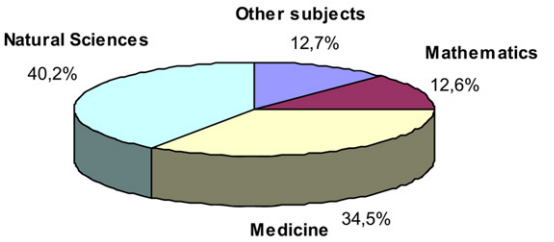

Fig. 3. Subjects covered in the New Series of the *Memoirs*.

1. Daniel Augusto da Silva: 2 papers, on number theory and geometry;
2. Albino Francisco de Figueiredo e Almeida (1803–1858): 1 paper, on mechanics;
3. Francisco da Ponte Horta (1818–1899): 3 papers, on geometry;
4. Luís Porfírio da Mota Pegado (1831–1903): 1 paper, on geometry;
5. José Manuel Rodrigues (1856–1916): 1 paper, on ballistics;
6. Ernesto Cesáro (1859–1916): 1 paper, on geometry;
7. Paul Barbarin (1855–1931): 1 paper, on (infinitesimal non-Euclidean) geometry;
8. José Nunes Gonçalves (1859–1917): 1 paper on ballistics.

Again we note the very small number of researchers publishing on mathematics in the *Memoirs*: only 8 for a 49-year period, two of whom were not Portuguese.[29] Also only two of them had more than one paper published, although now this has much more relative significance as there were other journals in which mathematicians could publish the results of their research, as in fact they did (Daniel da Silva, Ponte Horta, Mota Pegado). Also, only one of these authors, Daniel da Silva, had already published in the second series of the *Memoirs* of the Academy. The main theme is geometry: 7 of the 11 papers are on this subject, with ballistics, number theory, and mechanics being the other subjects. Furthermore, most of the papers on geometry are on classical geometry: conics (3 papers), analytic geometry (2 papers), and Euclidean geometry (1 paper). Only Barbarin's paper, *Eléments de géométrie infinitesimale non-euclidienne* (included in Tome VII, Part I), seems to be headed for the future. The year before the publication of his memoir, the Parisian editor C. Naud had published his monograph, *La Géométrie Non Euclidienne*, in the Physics–Mathematics series of *Scientia*, a journal whose aim was to publish works that would call attention to the changes in science. A year after the *Memoirs* publication, Barbarin was ranked second for the Lobachevski prize, just after Hilbert. For this prize the report on his work was made by Professor Mansion, who mentions five contributions to non-Euclidean geometry.[30]

The other non-Portuguese contributor, Ernesto Cesàro, presented a paper (in Tome VI, Part II) in Italian, *Forme poliedriche regolari e semi-regolari in tutti gli spazzi*, which he said was his first work,[31] written while he was a student (he dates it to Liège, 1881[32]), and dedicated to Luigi Cremona.[33] This paper was also published by the Lisbon Academy of Sciences in book form in 1886.[34] There is no indication in the *Memoirs* of the reason for including it in the journal one year after its publication in Lisbon in exactly the same form, so they may have come out at the same time, the Academy deciding to have Cesàro's paper published in book form as well. So we have two different

[29] The 11 papers of the New Series total 659 pages, an average of 60 pages per paper, with only 3 papers with less than 21 pages. There are four papers between 39 and 55 pages, and three between 75 and 95 pages. The longest, by Daniel da Silva, is 163 pages long. The total of 56 mathematical papers published in the *Memoirs* up to 1903 cover 2343 pages (excluding the 886 pages with tables of the Folque papers), with an average of 41.8 pages per paper. The majority of papers have up to 40 pages (37 of the 56 papers, 21 of which between 11 and 30 pages), with five papers between 41 and 50 pages, four between 51 and 60, four between 71 and 80, three between 91 and 100, and three over 160 pages.

[30] On Barbarin, see Halsted [1908]. I thank Professor Scott Walter, of Nancy University, for this reference.

[31] The fact that no bibliographical references are included in this paper indicates that the author was still at the beginning of his career.

[32] That is, two years before his first major work, "Sur diverses questions d'arithmétique," which was published in the *Memoires de l'Académie de Liège*.

[33] The last two pages of this paper include three additions dated 1885.

[34] In the Cesàro biography in the Dictionary of Scientific Biography, Lubos Navy and Jaroslav Folta state that Cesàro wrote his paper *Forme poliedriche regolari e semi-regolari in tutti gli spazzi* in 1878, and that it was published in Lisbon in 1888. However, the cover of the book published in Lisbon clearly states "Typographia da Academia Real das Sciencias, 1886."

cases: Barbarin's publication corresponds to his then current research themes, while Cesàro's paper was basically written while he was still a student.

If we analyze the distribution of the mathematicians contributing to the new series according to age, we can see that Figueiredo e Almeida was 51 when this series started, Daniel da Silva was 40, Ponte Horta 36, and Mota Pegado 23. None of them outlived this series, all dying before the end of 1903. The other four were born after the series began, between 1855 and 1859. By the end of 1903, the year of publication of the last volume we include in this analysis, they were aged between 44 and 48. So we see that in its essence, the average age of the scholars who wrote in the *Memoirs* did not change significantly during the 19th century.

Compiling the data on the six Portuguese mathematicians who wrote papers in the new series, and with the restrictions mentioned above, we can draw a general picture of the scholars in the *Memoirs'* new series. In contrast to the continuity found in the *second* series, we can see a change. Concerning the places where they had studied, there is a clear dominance of the military schools over Coimbra University (then the only existing university in Portugal): four studied in the former (Royal Academy of the Navy, Royal Academy of Ensigns, Army School, Royal Military College,[35] and Polytechnic School[36]), while only two were students in the latter. They were all professional soldiers and taught at military schools: Army School (2), Royal Military College (1), Navy School (2), and Polytechnic School (3). Only one of them also taught in a civilian school: José Manuel Rodrigues was also a teacher at the Oporto Institute of Commerce and Industry. In contrast to what was the rule in the first half of the century, only a minority were politically active: one Member of Parliament and one Deputy Mayor of Lisbon Council.

So we see that in the second half of the 19th century regarding the authors of mathematics papers in the Academy's *Memoirs*, there is a clear shift of influence from the University to the military schools, with the military avoiding the political arena.

3.4. The non-Portuguese papers

Very few papers in the *Memoirs* were written in languages other than Portuguese: only 16 out of a total of 334 papers published in the period 1797–1903, a mere 4.8% of the total. Of these 16 papers, 9 appeared in the first series, none in the second series, and 7 in the new series. No non-Portuguese papers appeared between 1821 and 1856. Three papers were written by Portuguese authors: two astronomical observations written in Latin appeared in the first series, in Tome I and in Tome III, Part II, and the above-mentioned zoology paper in French by Felix António do Brito Capelo was published in Tome V, Part II of the new series. The other 13 papers were written by 11 authors. One of these was Damoiseau de Monfort, mentioned above, with two papers in Tome III, Part I, of the first series; another was Dominici Vandelli (1730–1816), who had two papers in Latin in Tome I of the first series, on themes in zoology, botany, and geology. Like Damoiseau, he lived for some years in Portugal, arriving in the country at the invitation of the King's Prime Minister, the Marquis of Pombal, to teach a philosophy course at Coimbra University.

All this shows that there was never a policy to integrate the *Memoirs* into the network of scientific publications of the international community. Not only were there very few non-Portuguese authors, but also there was no continuity in their collaboration with the Portuguese community; it almost seems that these papers were published in the *Memoirs* by accident. There was no policy of which areas should be developed in close contact with non-Portuguese scholars, and there were no dominant themes in this set of non-Portuguese papers, with the single exception of the five papers on astronomical observations which appeared in the first four volumes of the *Memoirs*. These were a small part of a vast number of papers on astronomical observations that were included in these first three Tomes.[37] Besides these five papers, the other four non-Portuguese papers published in the first series (1797–1839) are on four different themes: astronomy, zoology and botany, medicine, and geology. Among the seven non-Portuguese papers published in the new series (1854–1903) we have two on mathematics, two on zoology, one on physics, one on medicine, and one on geology.

[35] The *Real Colégio Militar* (Royal Military College) was founded in 1803 with the name *Colégio de Educação* (College of Education) in its first years of existence. It was a secondary school under the authority of the War Cabinet, and it aimed to prepare its students to follow a military career.

[36] The Polytechnic School, in order to be independent from Coimbra University, started as a school of preparatory military instruction. It fell under the responsibility of the War Cabinet until 1859, that is, in its first 22 years of existence. See note 4.

[37] These five papers appeared in the *Memoirs* in 1797, 1799 (two papers), 1812, and 1814. Four of them were written in Latin. In this period a total of 26 papers on astronomical observations were included in the *Memoirs*.

With regard to mathematics, the situation is as bad as in other research fields: if we do not consider the more practical papers on astronomical observations, in 106 years we have only three mathematics and astronomy papers published by non-Portuguese authors, with 91 years separating the astronomy paper from the other two.[38]

Of the languages used, while in the first series Latin is dominant, with five papers, and there are only two each for French and Spanish, in the new series French is the dominant language, with four papers (reflecting the dominant influence of the French in Portuguese cultural life), while there are two in Italian and one in Spanish.

As a final note, it is interesting that there are also papers in Portuguese written by non-Portuguese scholars: Wilhelm, baron of Eschwege (around 1778–1855), who in Portugal was known simply as Guilherme, arrived in Portugal in 1802, at the invitation of the Minister Rodrigo de Sousa Coutinho, for mining works in Brazil, and stayed in Portugal and Brazil for many years. Between 1814 and 1837 he had four papers in Portuguese (on mineralogy, geology, and geography) published in the *Memoirs*.

3.5. A reflection on the impact of the Memoirs

The foundation of the Lisbon Academy of Sciences in 1779 came much later than that of the majority of the corresponding scientific academies of other European countries: for instance, the Royal Society of London was founded in 1662, the Académie Royale des Sciences de Paris in 1666, the Berlin Academy of Sciences in 1700, and the Saint Petersburg Academy of Sciences in 1724. The Memoirs of the Lisbon Academy appeared at a time when a network of scientific publications of these academies had already been established for decades, the earliest being the *Journal des Sçavants* and the *Philosophical Transactions of the Royal Society of London*, both having begun publication in 1665. Necessary conditions for a newcomer to enter this network in a meaningful way were, on the one hand, to be written in a language understood by a significant part of its potential readership, and on the other that it involved active scientific international exchange and correspondence. From what we see above, neither of these was the case for Portuguese mathematics in the *Memoirs*: Portuguese mathematicians wrote their papers in Portuguese, and very few non-Portuguese authors published in the *Memoirs* until the 20th century. Up to the time of Teixeira, there is written record of only a few Portuguese mathematicians who either submitted their papers to foreign academies or had any correspondence with non-Portuguese scientific journals. Among the exceptions to this general rule we have Garção Stockler, who exchanged letters with the *Edinburgh Review* on a mathematical question, and Manuel Pedro de Melo, one of whose papers was awarded a prize by the Copenhagen Academy [Saraiva, 2000]. Because of the turmoil in Portugal in the first half of the 19th century, a significant number of learned Portuguese, among them some mathematicians, went into exile. Some stayed in the countries to which they emigrated, others were there only temporarily, from a few months to a few years. As a consequence, a number of journals were created by Portuguese emigrants basically aimed at their own circle. This is a theme that deserves a study on its own, in particular concerning scientific matters. There is an overview of this subject concerning publications in England in Walter [1927], and more recently a more general overview in Reis [2007]. Some of these journals included mathematical matters. The most important, concerning mathematics in particular, is *O Investigador Portuguez em Inglaterra* (“The Portuguese Researcher in England”), a publication that lasted from 1811 to 1819, and which included both the Portuguese translation of John Playfair’s review of da Cunha’s *Principios Mathematicos* (“Mathematical Principles”) and João Manuel de Abreu’s

[38] It is possible that the fact that Barbarin and Cesàro submitted papers to the Academy (one of them published in book form, then later included in the *Memoirs*; see above) is in some way related to Gomes Teixeira’s international prestige. Both Cesàro and Barbarin were known to Gomes Teixeira and both exchanged letters with him. In the Coimbra University Archive there are letters written by Cesàro and Barbarin to Gomes Teixeira. From Cesàro there is one letter from 1894 and two from 1897, the subject common to all letters being papers published in Teixeira’s journal. In one of the latter he mentions he is sending a note to be published in the journal and states that he has several short papers to be sent to Teixeira for publication. In the same Archive there are seven of Barbarin’s letters to Teixeira, six from the period 1910–1912, and one from 1928. They show that there is a lasting relationship between them which extends to their families (when Teixeira visited Barbarin in Bordeaux in 1910, he took his daughters and son-in-law with him). In one of the 1910 letters Barbarin says he used Teixeira’s *Treatise on Curves* to obtain results included in a short paper which was to be published by *L’Enseignement Mathématique*. In the 1928 letter Barbarin thanks Teixeira (and also Rodolfo Guimarães) for publishing one of his papers in his journal, saying that the paper was central for the greatly improved third edition of his *Géométrie non-euclidienne*, which had just been published. So we see that although we can surmise that there is some connection between Teixeira and the publication of these papers, there is no clear link between them. The case for Cesàro is probably stronger, as his correspondence with Teixeira is close to the date of publication of his paper in book form, while there is no evidence that Teixeira had met Barbarin by 1903. Cesàro became a corresponding member of the Academy in 1892, while Barbarin was nominated in 1915.

and Anastacio Joaquim Rodrigues' long responses. But as a rule, no mathematics of this period is known to have been published by Portuguese mathematicians either in emigrant-founded journals or in non-Portuguese journals.

This state of affairs meant that the influence of the writings of Portuguese mathematicians in the international community of mathematicians was practically nonexistent. It had to wait until Teixeira's *Jornal de Sciencias Mathematicas e Astronomicas* started publication in 1877 for the situation to change. Teixeira made sure that in his journal Portuguese authors wrote a significant number of papers in French, and there was active participation of foreign mathematicians in the journal's issues.

In spite of this inability to participate actively in the international community of mathematicians, there was no ignorance on the part of Portuguese mathematicians of at least some of the developments of mathematics in Europe,[39] and some papers published in the *Memoirs* could have caught the attention of other European mathematicians had the *Memoirs* had a different orientation and a significant readership in Europe. I will highlight a few cases of Portuguese contributions to mathematics which were worthy of recognition by the international community of mathematicians, but remained unknown to the great majority.[40] These examples show that the fact that Portuguese mathematicians were ignored by the international community did not mean that they were not aware of what was being done in Europe. In fact in the cases I shall discuss, the authors show reasonable knowledge of European mathematics in the areas that concern their papers, some of it produced near the time of their writings. I have selected five examples, given in chronological order, from a paper published in 1799 in Tome II of the First Series, to a paper that appeared in 1854 in the New Series, Tome I Part I.

3.5.1. "Computation of the orbits of comets,"[41] by José Monteiro da Rocha

This paper was read to the Academy at the public session of January 27, 1782. In it Monteiro da Rocha gives a general overview of the computation of trajectories of comets. He mentions Newton's *Principia* and Euler and his *Theoria Motuum Planetarum et Cometarum*. He argues that Euler, tackling the problem in a more general way than Newton, is taking as known what is the greatest difficulty in this matter, involving an enormous amount of computation: to know approximately the distance of the comet to the Earth at the average time of observation. Hence he comments that astronomers, not being able to follow either Newton or Euler, had to try indirect methods, and he mentions Halley, Lacaille, Pingré, and Lalande. Then he refers to the Berlin Academy prize for 1774: "To obtain general and rigorous formulas to determine the parabolic trajectory of a comet, using three observations, and that they should be used to solve this problem in the simplest and most exact way,"[42] noting that, as no satisfactory papers on the subject had been submitted, the competition was extended until 1778, with the monetary prize doubled. Da Rocha says that he does not know if there was any successful memoir on this subject, but he is presenting a method which he believes satisfies the requirements of the Berlin Academy. He ends his paper by applying his method to the computation of the orbits of the 1680 and 1759 comets. There is no indication that his memoir was submitted to the competition.

Here we have a measure of the scientific isolation of the Lisbon Academy. This was certainly due in a part to the times, but it was also the consequence of an idea among Portuguese academicians of what an academician should essentially be: someone whose main concern is the intellectual exercise (in pure or applied matters), the production of valuable work resulting from his own research, in his own scientific community. If the work corresponded to results new to the international community, so much the better; but this came as a bonus, and was not the leitmotiv of his research.

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[39] It is worth mentioning that a Portuguese translation of Lagrange's *Théorie des Fonctions Analytiques* was published in Lisbon in 1798, one year after its publication in Paris. The translation was by Manoel Jacinto Nogueira da Gama (1765–1847), a graduate in mathematics and philosophy at the University of Coimbra, and a teacher at the Royal Academy of the Navy from 1791 to 1801. His Portuguese translation of Lazare Carnot's 1797 work *Réflexions sur la Métaphysique du Calcul Infinitésimal* also appeared in the same year, predating William Dickson's English translation (1800–1801), J.K. Hauff's German translation (1800), and G.B. Magistrini's Italian translation (1803). For more information on da Gama, see da Silva [1858–1870, vol. VI, pp. 7–8, and vol. XVI, p. 227].

[40] For more information on this topic, see Agudo [1986]. Agudo's paper gives an overall view on the Academy's scientific papers published in the *Memoirs*, and he groups them in four sections: natural sciences, chemistry, physics, and mathematics. The last is the most developed part of his paper (pp. 1318–1334).

[41] "*Determinação das órbitas dos cometas*," in Tome II, 1799, pp. 402–479.

[42] "Que se dessem formulas geraes, e rigorosas, para determinar a orbita parabólica de hum cometa, por meio de tres observações; e que se mostrasse o uso dellas, para resolver o Problema do modo mais simples e mais exacto," p. 404.

The first volume of the Academy's *Memoirs* only appeared 15 years after da Rocha read his paper to his peers, and it was only published in the second volume of the Memoirs, in 1799. By this time the German astronomer Heinrich Wilhelm Matthaus Olbers (1758–1840) had already published a solution similar to the one found by Monteiro da Rocha.[43]

3.5.2. "Reflections on certain successive sums of terms of arithmetic series, applied to solutions of several algebraic questions," [44] *by José Maria Dantas Pereira*

This is a paper Pereira read to the Academy on January 8, 1794. In it he mentions papers by Lagny in the *Memoirs of the Paris Academy of Sciences* in 1706, and by Lagrange in the *Memoirs of the Berlin Academy* in 1767 and 1768.[45] These papers concern subjects similar to the ones Pereira is researching. He also notes some comments by Bézout, although he does not specify where or when these were made. He goes on to discuss the speed of convergence of the approximation method he proposes in his paper, and mentions that, to the best of his knowledge, the method reported to the Paris Academy of Sciences by the Marquis of Courtivron[46] in 1774 was the quickest. Although he does not mention papers nearer to the time his own was produced, we can see from these references that the author had some knowledge of the mathematics produced in his field. The method proposed by Pereira to solve equations is essentially the one known today as Horner's method, and this English mathematician[47] published a paper on the subject in the *Philosophical Transactions of the Royal Society* in 1819.[48]

3.5.3. "Foundations of elementary algorithmy,"[49] *by Francisco Simões Margiochi*

The case of the Portuguese mathematician José Anastácio da Cunha (1744–1787) is well known.[50] In his main work, *Principios Mathematicos*, published three years after his death,[51] some important innovations were presented, which remained unknown to the international community until A.P. Youschkevitch (1906–1993) published two important papers on da Cunha.[52] In particular he gave a definition of convergence of series that anticipated Cauchy's[53] and used it correctly in his book to determine the convergence of certain series. Some of da Cunha's students continued his work in mathematics, among them Anastácio Joaquim Rodrigues (?–1818). The debate on da Cunha's work was initiated when J. Playfair published a review of his *Principios Mathematicos* in the *Edinburgh Review* in 1812.[54] Playfair could not see the important innovations that da Cunha was making, and this led some of da Cunha's disciples to write on the subject.[55] It is reported in the section "History of the Academy" in Tome III, Part II of the *Memoirs*[56] that Rodrigues read to the Academy[57] his *Memoria apologetica e illustrativa dos Principios Mathematicos do Cel. José*

[43] In 1796 Olbers calculated the parabolic orbit of a comet using a new method devised by himself. It was published in book form in Weimar in 1797 by the Verlage des Industrie-Comptoirs, with the title *Abhandlung uber die leichteste und bequemste Methode, die Bahn eines Cometen aus einigen Beobachtungen zu berechnen*. His method was used throughout the 19th century.

[44] "*Reflexões sobre certas sommações successivas dos termos das séries aritméticas, applicadas às soluções de diversas questões algébricas*," Tome II, 1799, pp. 168–186.

[45] As far as I know, Lagrange did not publish any papers in the Berlin *Memoirs* in these two years. It may be that Pereira is referring to *Sur la resolution des equations numériques*, published in Volume XXIII, 1769, and reprinted in his *Oeuvres*, volume 2, pp. 539–578, and *Additions au Mémoire sur la resolution des equations numériques*, included in Tome XXIV, 1770, and reprinted in his *Oeuvres*, volume 2, pp. 581–652.

[46] Gaspar le Compesseur de Créguy-Monfort de Courtivron (1715–1785).

[47] William George Horner (1786–1837) seems not to have been the first person in the West to describe the method that carries his name. Others before him, such as Paolo Ruffini (1765–1822), anticipated it. It seems that Horner's prominence in this matter was partially due to Augustus De Morgan (1806–1871) mentioning him in some of his papers.

[48] "A new method of solving numerical equations of all orders, by continuous approximations," Vol. 109, pp. 308–335.

[49] "*Fundamentos de Algorithmia Elementar*", in Tome III, Part II, 1814, pp. 27–60.

[50] On da Cunha see Ferraz et al. [1990] and Queiró [1992].

[51] There is a possibility that the book was only published in 1798. See Carvalho e Silva [2000].

[52] See Youschkevitch [1973, 1978].

[53] On the comparison between da Cunha and Cauchy's approaches to this subject, see E. Giusti's paper in Ferraz et al. [1990, pp. 42–45].

[54] This review is transcribed in Ferraz et al. [1990, pp. 415–423].

[55] Rodrigues published in the *Moniteur Universel* (a Paris journal founded in 1789 by J.C. Panckouke) a review of a defense of da Cunha's book, *Principios Mathematicos*, which was written by another of da Cunha's disciples, J.M. De Abreu. See Rodrigues [1811].

[56] This was the first time such a section was included in an issue of the *Memoirs*.

[57] This is mentioned in the transcription of a speech made by the then secretary of the Academy, José Bonifácio de Andrada e Silva (1763–1838), on June 24, 1813.

Anastácio da Cunha,[58] in which he criticized Playfair for his inability to understand the innovations that da Cunha presented in his book.[59] So it is not surprising that some of da Cunha's ideas should surface in a paper in this volume, the first one to appear after the publication of Playfair's review and the resulting debate, as is the case of this paper by Margiochi. He discusses elementary operations and their properties, and with regard to infinite sums he defines series and their convergence, repeating da Cunha's definitions.

3.5.4. "Memoir awarded at the public session of June 14, 1818, for the programme proposed for the same year,"[60] *by João Evangelista Torriani; and "Memoir aimed at proving that the complete literal equations of degree higher than four cannot be solved exactly,"* [61] *by Francisco Simões Margiochi*

The Academy program for 1818, in analysis, set out "to prove the formulas proposed by Wronski for the general resolution of equations." Torriani presented the above memoir, and was awarded a prize. In it he proved that following Wronski's method (he mentions one of his papers, published in Paris in 1812, which can only be his *Résolution générale des equations de tous les degrés*), equations of degree higher than 3 cannot be solved. And he adds,

> I think Wronski made a mistake, as Newton, Bernoulli, and other great Geometers made mistakes on other matters, but this does not diminish my consideration for this profound Geometer, and his other works.[62]

In the second paper, published two years later, Margiochi acknowledges Torriani's paper, stating that its content was essential for the results obtained. Although not all what Margiochi claims to prove can be concluded from what he presents, in his paper there is a general method for solving equations of the second, third, and fourth degrees which do not have the second term. This method was later rediscovered by the French mathematician Louis Olivier[63] (17??–18??) and published in Crelle's journal in 1826.[64]

3.5.5. "Memoir on the rotation of forces on their application points"[65]*, and "General properties and direct resolution of binomial congruences. Introduction to the study of number theory,"*[66] *both by Daniel Augusto da Silva*

As mentioned above, Daniel da Silva is considered to be, together with Francisco Gomes Teixeira, one of the most important Portuguese mathematicians of the 19th century. In the first paper above he obtained original results. Many of these would be obtained independently a quarter of a century later by Gaston Darboux, who included them in his 1877 paper *Mémoire sur l'équilibre astatique et sur l'effet que peuvent produire des forces de grandeurs et de directions constantes appliquées en des points déterminés d'un corps solide, quand ce corps change de position dans l'espace*.[67] Da Silva was surprised and distressed by this situation, as the *Memoirs* of the Lisbon Academy were also regularly sent to the French Academy of Sciences. He tried to establish the priority of his results, and wrote a "Réclamation de Priorité," a letter to the editor of *Deux Mondes*, the journal through whose pages he became aware of the situation. This seems to have been a bad decision, as the newspaper was not widely read, and therefore da Silva's work remained unknown. He should have written directly to the Academy of Sciences in Paris, which would have had much more

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58 "Apologia and illustrative memoir on the Mathematical Principles of José Anastácio da Cunha."

59 Similarly Gauss, in a letter to Bessel, criticized an anonymous review of da Cunha's book published in *Göttingische gelehrte Anzeigen*. This is reported in Youschkevitch [1978].

60 "*Memoria premiada na sessão publica de 14 de Junho de 1818 sobre o programma proposto para o mesmo anno*," Tome VI, Part I, 1819, pp. 33–50.

61 "*Memoria com o fim de próvar que não podem ter forma de raízes as equações literaes e completas de grau superior a quatro*," Tome VII, 1821, pp. 317–349.

62 "Eu julgo que Wronski se enganou assim como Newton, Bernoulli, e outros grandes Geómetras em outras matérias se enganárão, e refutando a sua resolução geral das equações de todos os gráos, nem por isso fico apreciando menos este profundo Geómetra, e suas outras producções," p. 37.

63 On Olivier, see Sørensen [2006].

64 *Bemerkungen uber die Form der Wurzeln algebraischer Gleichungen*, pp. 97–116. In this paper Olivier also analyzes the case of the fifth-order equation without the second term. See in particular pp. 109–113. This issue of Crelle's journal includes six more papers by Olivier, three in the Analysis section and three in the Geometry section.

65 "*Memoria sobre a rotação das forças em torno dos seus pontos d'applicação*," second series, Tome III, Part I, 1851, pp. 61–231.

66 "*Propriedades geraes e resolução directa das congruencias binómias. Introdução ao estudo da Teoria dos Numeros*," New Series, Tome I, Part I, 1854, pp. 1–163.

67 *Mémoires de la Société des Sciences Physiques et Naturelles de Bordeaux*, Second Series, Tome 2, pp. 1–65. Darboux's paper was also published separately in the same year, both in Paris (publisher: Gauthier–Villars) and in Bordeaux (publisher: Imprimerie G. Gounouilhou).

impact. The fact that the da Silva paper was not known in France in spite of the *Memoirs* of the Lisbon Academy being available in Paris tells us something of the extreme ignorance of the *Memoirs* outside Portugal.[68]

The second paper was read by da Silva to the Academy at the session of March 24, 1852. In it he gives a method of solving systems of linear congruences. He is considered [in Gomes Teixeira, 1934, 293; Agudo, 1986, 1334] to have been the first to do so until the Irish mathematician Henry John Stephen Smith (1826–1883) wrote about this topic in 1861.[69] Both papers confirm that da Silva was a well-informed mathematician. For example, let us look at the second of the above-mentioned papers in more detail.[70] Da Silva contextualizes his work, mentioning Fermat, Euler (and some of his works, such as the articles in the *Comm. Acad. Petrop.*, Tomes VI and VIII, in the *Nova Acta Petrop.*, Tome VIII, and in the *Novi Comm. Acad. Petrop.*, Tome XVIII), Lagrange (*Additions a l'Algèbre d'Euler*, and an undisclosed 1767 paper), Legendre's *Théorie des Nombres*, Gauss' *Disquisitiones Arithmeticae* (in da Silva's own words, "the most profound, complete and highly original work in this field"[71]), Poinsot's *Reflexions sur les Principes Fondamentaux de la Théorie des Nombres*, and Serret's *Cours d'Algèbre Supérieure*. He must have been one of the first Portuguese mathematicians to mention Cauchy; in this paper he refers to his 1829 work *Exercices de Mathématique*, Tome IV, although he adds that he could not obtain it (p. 65). He notes with satisfaction that the French Academy of Sciences has, for the second time, proposed for the major mathematics prize the proof of one of Fermat's theorems. For him this is "like a solemn document of nobility for number theory, rewarded with all its authority by that illustrious corporation."[72]

It is also interesting to note that in his paper da Silva mentions an unpublished work by one of his predecessors at the Academy, F.S. Margiochi. He discusses this work and ends up doubting the validity of the method used by its author, expressing this idea in a elegant way:

> The induction used by this distinguished analyst is far from evident. . . .[73]

With this da Silva shows that he was aware of what was being done not only in the international community, but also in Portugal, having taken the trouble to look into unpublished manuscripts.

3.6. *On the refereeing system*

The 1779 statutes of the Academy [Lisbon Academy of Sciences, 1780] say little on refereeing, probably because at the time it was not an explicit short-term aim for the Lisbon academicians to found a scientific journal. In fact the first issue of the first journal produced by the Academy, the *Economics Memoirs*, was only published 10 years later.[74]

The writing of memoirs is mentioned in Paragraph IV, which states that a condition for someone to be a full member or a supernumerary member is to present at least one memoir per year or to give some other proof of his involvement[75] in the Academy (the statutes are no more precise on this point). There is no mention of refereeing the works of existing members of the Academy, so probably in the beginning there was no refereeing for Academy members: it may have been thought that the process they had to go through to become an Academy member was sufficient to guarantee the quality of writings produced. In support of this hypothesis we have the contents of Paragraph XXIV, about the

68 This episode was crucial for Gomes Teixeira's decision to go ahead with the publication of *Jornal de Sciencias Mathematicas e Astronomicas*. Significantly the first paper Teixeira included in his journal not written by himself (he wrote all the papers in the first two issues) was a reprint of Daniel da Silva's "Réclamation de Priorité." See Saraiva [2005, 170–172].

69 "On systems of linear indeterminate equations and congruences," *Philosophical Transactions of the Royal Society of London*, volume 151, pp. 327–356.

70 In a note by the publishers of the *Memoirs* it is stated that da Silva had been seriously ill for a long time, so for that reason he had been able to revise neither the preface nor the final part (from p. 117 onwards) of his memoir. For the same reason the last two chapters are incomplete: in the ninth some theorems are missing he would like to have added; and he was only able to write an abstract of the intended contents of the tenth chapter.

71 "a obra mais profunda, mais abundante, e elevadamente original neste género," p. 2.

72 "é um solemne documento da nobilitação da theoria dos numeros ratificado com toda a autoridade daquella corporação illuste," p. 2.

73 "A inducção de que faz uso esse distinto analysta está mui longe de ser evidente," p. 13.

74 "Memórias de Economia." Five volumes were published between 1789 and 1815.

75 "Algum outro testemunho da sua applicação," p. 5.

memoirs read by Academy members or offered to the Academy. It states that they belong to the Academy, which can publish them in either a complete or abridged form, or even in translation. However, it is added, *their authors will be contacted in order that they give a final form to their papers, according to their own judgment*.[76] Also on this point, as a note (which was added later to the Academy's original text, when the Academy decided to publish it), there is mention of refereeing the memoirs presented by those who are either applying to be full members or entering a competition for an Academy prize. And as a note to Paragraph XXIV there is the statement that the Academy's *Memoirs* will only include either original work, or work that improves on existing papers, in a way that it will interest the readers.[77] This is a resolution from the Full Members Meeting of January 30, 1780, which took place only a little over one month after the Academy's foundation (on December 24, 1779). The only implicit reference to refereeing is in Paragraph XI, and it concerns only memoirs submitted to the Academy's competitions, on which it states that the memoirs awarded prizes by the Academy will be read in the July Public Assembly.

Forty-two years later the Academy published a compilation of its regulations and statutes organized by Francisco Manuel Trigoso d'Aragão Morato[78] [Morato, 1822]. This text is more precise and gives more details on the functioning of the Academy, but the changes it made to the 1779 statutes are only minor.

At the Full Members Assembly of March 12, 1812, the Academy had ordered the compilation of its laws and regulations [Morato, 1822, 9]. Three months later, it was decided to publish this compilation, as can be seen in the subtitle on the cover of the resulting book[79]:

> Ordered to be printed by the resolution of the special session of June 13, 1812 [...] and a second time approved and ordered to be printed by resolution of the Council Meeting of January 15, 1815.

We also know that the compilation was ready soon after it was ordered for the first time: the date at the end of the Preface is June 19, 1812. There is no explanation given for the delay in publishing the book.

In the Preface Morato states clearly what he did:

> I read all Books and bundles of Abstracts [...] I carefully sorted all Regulations corresponding to its economic and literary governance [...] I classified them [...] following the systematization and structure laid down in the Plan of Statutes; then I rewrote all those resolutions with these Statutes [...] and I made a complete whole of the present Academic Statutes.[80]

The book has 23 chapters, of which 2 concern refereeing: Chapter XXI (*On the Memoirs submitted for the Academy's prizes*) [Morato, 1822, 60–64] and Chapter XXII (*On the Memoirs of the Academy, and its Collections*) [Morato, 1822, 64–68].

In the former Morato mentions that each Academy competition should consist of three questions, one for each class, and each prize should be awarded by the respective class.[81] It goes on to describe the usual method of submission for a competition. We note that full members and honorary members were excluded from these competitions, and that the Academy explicitly stated that the fact that a memoir was awarded a prize by the Academy did not mean that the Academy agreed with all its contents, but solely that it considered that overall the memoir deserved to be rewarded.

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76 "sendo porém os seus Autores ouvidos, para as retocar como melhor parecer," p. 24.

77 "A Academia tem declarado, que não serão incluidas nas suas Memorias senão cousas novas ou aperfeiçoadas de maneira, que interessem o publico," p. 14.

78 Morato (1777–1838), a doctor and teacher of canon law at Coimbra University, had been elected a member of the Academy on December 15, 1810. He was Vice-President of the Academy in 1834. He has several of his papers published in the Literature section of the Academy's *Memoirs*. More information on him, including an extensive list of published works and manuscripts, can be found in da Silva [1858–1870, Vol. II, pp. 458–461, and Vol. IX, p. 337].

79 Morato says in the *Introduction* that he was appointed to write this compilation at the Full Members Assembly of March 13, 1812.

80 "[...] consultei todos os Livros e Maços de Minutas [...] separei cuidadosamente todos os Regulamentos pertencentes ao seu governo economico e literario [...] classifiquei-os [...] segundo a ordem e systema do Plano de Estatutos [...] formei um todo completo dos actuaes Estatutos Academicos," pp. 9–11.

81 The text mentions that this was an Academy rule from its foundation until 1789; from that year until 1807, more than one question was proposed per class. Then at the Full Members Meeting of April 20, 1807 it was decided to return to the initial resolution of one question per class. Morato notes that in 1810 and in 1812 more than one question per class was proposed.

The later chapter defines the refereeing procedure for papers submitted by Academy members. This is mainly the result of a Full Members Meeting, held on September 10, 1786. It was then decided that each submitted memoir should be analyzed by three referees, who should be full members of the Academy, and of the class to which the submitted memoir belonged. Each of the referees should send a written report of the paper to the Secretary of the Academy. The Academy defined what should be emphasized in the reports. Besides mistakes and shortcomings, the referees should point out, as notes or in a separate chapter, all that in their opinion would improve the style, method, and contents of the paper. The secretary would then pass the referees' comments to the author, without disclosing their identities. The author was free to act as he thought best, accepting all, part, or none of what was proposed by the referees. However, he should either correct the mistakes and damaging errors, or reply to the referees' remarks, so his paper could be examined again, by the same or a different group of referees, or at a Class Meeting [Morato, 1822, 66].

At a Full Members Meeting held on November 10, 1786, it was stated that the Director of each class should always be one of the referees, and that he should have the main role in analyzing the memoir. The two other referees (named "*fiscais*," which can be translated as "inspectors") are explicitly told to help the Director in his task. All decisions would be taken at the Full Members Meeting of the class to which the paper belonged: the Director would read his report, and written reports by the inspectors or by any other member should be available, so that there would always be three reports. This new regulation maintained the right of all Full Members to be considered inspectors for papers in their class. Almost 30 years later, at the Full Members Meeting of May 6, 1813, there was another change in the refereeing procedure: a Full Members Standing Committee was created, elected for one year, to be permanently active. The committee would examine the quality of language regarding good manners and public decency of all accepted memoirs. Later, at the Full Members Meeting of July 7, 1814, it was decided that the third referee for any memoir of any class should be a member of the Arts Class, who would only analyze the language used, and therefore the resolution of May 6, 1813 was implicitly canceled, and that of November 10, 1786 was modified [Morato, 1822, 67/68].

In the important reform of 1851 the production, refereeing, and publication of quality papers have an important place. The aims of the Academy are defined in Article 1 of the new statutes [Anon., 1852, 534–537]. Then in Article 2 the means to achieve them are defined. Among these are the refereeing of memoirs and any other scientific productions presented to the Academy (paragraph 2), the publication of memoirs by its members or others "*which are thought to be worthy of publication*" (paragraph 4), the proposal of important scientific questions, and awarding prizes in public competitions, the decisions being made by the classes to which those memoirs belonged.

The importance of publishing papers is highlighted in Article 26, which states that a necessary condition to remain a full Academy member is to publish at least one scientific paper every two years. In cases when this did not happen and there was no proper justification for this temporary lack of publications, it was assumed that the member had renounced his membership of the Academy.

In Article 25 it was stated that a Regulation of the Academy should be produced. This was done, and was approved by the King on November 6, 1852 [Anon., 1853, 583–590]. It consisted of 10 chapters, with a total of 78 articles. Of these 10 chapters, 3 concern refereeing: Chapter VIII, *On the Publications of the Academy*, Chapter IX, *On the Election of Members*, and Chapter X, *On Prizes*. It was restated that memoirs could only be published in the Academy's journal after approval by the corresponding Class. The refereeing process is described in detail in Articles 55 and 58 [Anon., 1853, 588–589]. The memoir would be given to two members for them to write reports. If the memoir was written by an Academy member, they had to justify their opinions only if they recommended changes to the paper. If it was submitted by somebody else, in all cases the report should include the reasons for its opinions. The admission of members, regulated in Chapter IX, is said to depend on the candidate's scientific writings. This would be analyzed by the section of the corresponding class to whom the candidate would apply. The report would be read and discussed in one session of the class [Anon., 1853, Article 64, p. 589]. As for the prizes of the Academy, it is stated in Chapter X that the Academy would propose problems, set by each Class, on a yearly basis, and that the submitted memoirs would be analyzed by the corresponding Classes, which would decide whether to award the prize. It is also stated in Article 71 that full members could not submit memoirs to these competitions.

Up to the end of the 19th century there were minor changes in the statutes (in 1855, 1865, and 1872) but none concerned refereeing.

Only once during the whole 19th century is there an explicit mention in the *Memoirs* of the work of referees. This is in Tome I, Volume I of the New Series (1854), significantly in the report made by the then life secretary of the

Class of Mathematical, Physical and Natural Sciences, António Joaquim de Figueiredo e Silva (1807–1857).[82] This was a report on the activities of the First Class between March 1, 1852 and June 16, 1854, an important report, as the Academy had just undergone its most significant reform during the 19th century by the Decree of December 13, 1851, as has been mentioned above. There was a need to foster the production of research papers in the First Class of the Academy, and the report mirrored that necessity. On March 1, 1852 there were 14 members in the First Class of the Academy. Since then a few had retired, others were ill, and the dynamics of the sessions were seriously affected. It was therefore decided to admit proposals for 7 new full members; and it is in this context that there is a reference to the referees and their work. The only detailed case is that of the only mathematician who applied for a place, Albino Francisco de Figueiredo e Almeida. For the others there is only mention that they were accepted. Almeida submitted his *Memoir on the equilibrium of systems or formula of virtual velocities*.[83] Figueiredo e Silva in his report stated:

> The referees who were charged with examining this memoir particularly note the originality of its writing, and often find in it formulas and theorems either more general than the ones that are known, or completely new ones, with very elegant proofs [...] It is the opinion of the censors given the task of analysing the memoir of Mr. Albino de Figueiredo, that the principle of virtual velocities is shown by him in its maximum generality, the demonstration of how all forces acting and developing in a system combine to produce that principle, leaves nothing to be desired, nor do we know any proof so complete.[84]

3.7. Some comparisons with mathematics in 19th-century Spain

It would be interesting to compare the panorama of publication of the Portuguese Academy in the 19th century with that of its Spanish counterpart, but as far as I know through Spanish and Argentinean colleagues and from reading research papers, there is no published study of the Spanish situation, only studies of particular non-Academy journals, such as the *Periodico Mensual de Ciencias Matemáticas y Físicas* and *El Progreso Matematico*.[85] Also, with the exception of Ortiz [1996], the papers on 19th-century Spanish mathematics only occasionally contain marginal references to Portuguese mathematics and mathematicians.

In Ortiz [1996] there is a comparative analysis of mathematics in Spain and in Portugal in three periods of the 19th century. More specifically, these three periods are analyzed in terms of mathematical exchanges between the international mathematical community and the Iberian periphery. The first relates to the mathematics used in problems in geography and navigation from the end of the 18th century to about 1810. The second concerns the time when the Iberian peninsula began once again to play an active part in international commerce, and is related to the mathematical knowledge needed to establish professional training centers for the new professions, especially for engineers. The final one relates to the last two decades of the 19th century and up to World War I, and analyzes the international contacts developed by Portugal and Spain in connection with the modernization of mathematics teaching. It is in this third period that Spanish and Portuguese journals are mentioned, in relation to what are called intermediate journals. We will return to this later.

In the inaugural lecture of the Mathematics Section of the Valladolid Congress of the Spanish Association for the Progress of Science [Rey Pastor, 1915], the Spanish mathematician Julio Rey Pastor (1888–1962) sets out to debate what Spain's attitude toward science should be: should Spanish scientists limit themselves to assimilating the successive developments of science or should they actively collaborate in its making? Rey Pastor emphasizes that this is an important question, as its answer will determine which pedagogical policy is best for Spain. In order to answer these questions, he analyzes the mathematical past of Spain in the 19th century. His analysis shows that the path of Spanish mathematics in the 19th century was in many ways similar to Portugal's, although there was no significant

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82 On Figueiredo e Silva see da Silva [1858–1870, vol. I, pp. 160–161, and vol. VIII, p. 182].

83 "Memória sobre o equilíbrio dos systemas, ou formula das velocidades virtuaes," included in the same Tome, pp. I–XII and 1–27.

84 "Os censores a quem foi commetido o exame desta memoria notaram especialmente a originalidade com que é escripta, e nella encontram a cada passo formulas e theoremas ou mais geraes do que os já conhecidos, ou inteiramente novos, e demonstrações muito elegantes [...] Segundo o parecer dos censores encarregados da memória do Sr. Albino de Figueiredo, o princípio das velocidades virtuaes é por elle apresentado no seu maior estado de generalidade; a exposição do modo como todas as forças, que actuam e se desenvolvem em um systema qualquer, se combinam para dar aquelle princípio, nada deixa a desejar, nem se conhece demonstração mais completa," pp. 5–6.

85 That is, the situation described in Hormigón [1993a], in particular on p. XVI, has not changed significantly.

contact between mathematicians of the two countries before the last quarter of the century. As in Portugal, and for similar reasons, the first half of the century had produced little mathematics in Spain:

> We mark the year 1845 as the starting date for the scientific life of our country. First the war of independence; then revolution and anarchy; later a civil war, all contributed to a background which truly was not at all conducive to the peaceful development of science.[86]

However, the beginning of the century had promised a different prospect for Spain. Eduardo Ortiz states that the generation of Spanish scientists born around 1760 was "the most brilliant, original and internationally renowned [which] that cultural area has produced in modern times" [Ortiz, 1996, 326]. The majority of the members of this generation, as Ortiz emphasizes, carried out their activities in an international context. There was, above all, Joseph de Mendoza y Rios (1762–1816), a Foreign Fellow of the Royal Society of London, the Académie des Sciences of Paris, and other European academies, but also Felix Bauzá (1764–1834), José de Lanz (1764–1839), and Agustín de Betencourt (1758–1824). All worked not only in Spain but in other European countries such as England, France, and Russia. Others, such as José Chaix (1766–1811), although mainly based in Spain, established contacts with French mathematicians [Ortiz, 1996, 327]. However, as in Portugal, this early promise did not blossom, and many of these scientists had to go into exile because of political instability and conflict.

Rey Pastor says that until 1845 scholastic teaching of physics and mathematics was dominant in Spanish universities. This date is important because it marks a reorganization of the physical and mathematical sciences at university level, with the foundation of a special section for exact sciences within the Faculty of Philosophy and Arts. Two years later the Madrid Royal Academy of Sciences was founded, and its journal began publication in 1850 under the title *Revista de los progresos de las Ciencias exactas, físicas y naturales* ("Journal for the advancement of exact, physical and natural sciences"), a title which it kept until 1904. This journal included translations of papers from French journals such as that by Liouville and the *Comptes Rendus* of the French Academy of Sciences. It marked the beginning of the import of French works: Rey Pastor mentions Cyrodde, de Fourcy, Bourdon, Vincent, Navier, Cournot, etc. Another important event was the founding of the Faculty of Sciences in Spanish universities (by the Moyano decree) in 1857, with a mathematics curriculum that represented an extension of the existing mathematics studies. In Portugal it was the 1772 reform by the Marquis of Pombal, King D. José's Prime Minister, that marked the founding of the first Faculty of Mathematics in Portugal and the modernization of the mathematics curriculum, with textbooks by Etienne Bezout, Charles Bossut, Abbé Marie, and Nicolas Lacaille.[87] Ortiz mentions in his 1996 paper that the long gap between these corresponding events in Spain and in Portugal had the consequence of pure mathematics becoming "a more serious academic concern in Portugal than in Spain and, for a considerable period, pure mathematics tended to be closer to modern developments in Portugal than in Spain" [Ortiz, 1996, 326].

The period 1865–1890 marks an extensive renewal of contents in mathematics teaching and research. Rey Pastor emphasizes the work of José de Echegueray y Eizaguirre (1832–1916), whom he considers to be the pioneer of the transition in Spain from 18th-century mathematics to the mathematics of Cauchy and Gauss. This period culminates with the foundation in 1891 by Zoel García de Galdeano y Yanguas (1846–1924) of the first mathematics journal in Spain, *El Progreso Matemático* ("Progress in Mathematics"), 14 years after its Portuguese counterpart, Gomes Teixeira's journal.[88]

In Ernesto García Camarero's paper on mathematics in Spain in the 19th century [García Camarero, 1984] we find a similar overview of the Spanish situation. At the beginning of the paper [pp. 115–117], there is a very useful account of the work produced on the history of mathematics in Spain in the 19th century, from Gumersindo Vicuña's speech at the opening of the 1875/1876 academic year at the Universidad Central on the situation of the physical and mathematical sciences in Spain at the time, to Mariano Hormigón's 1982 Ph.D. thesis, *Problemas de Historia*

[86] "Suele señalarse el año 1845 como fecha em que comienza la vida cientifica de nuestra nación. La guerra de la Independencia, primero; la revolución y anarquia, después; una lucha civil más tarde, habían formado durante la primera mitad del siglo un ambiente nada propicio, en verdad, para el tranquilo cultivo de las ciencias" [Rey Pastor, 1915, 7].

[87] On the Pombal reform, see Albuquerque [1990], or, in a more abriged form, Saraiva [2007, 20–22].

[88] This was two years after the founding in Buenos Aires of the first Argentinean mathematical journal, the *Revista de Matematicas Elementales*, by Valentin Balbín (1851–1901). Galdeano was a contributor to this journal.

de las Matemáticas en España entre 1870 y 1920 ("Problems of the history of mathematics in Spain between 1870 and 1920"), centered on the figure of García de Galdeano.

García Camarero gives short accounts of the subjects analyzed in these works, and from this we see that none focuses on the study of journals. In his paper he proposes a periodization of Spanish mathematics in the 19th century.[89] As in Rey Pastor's paper, some similarities can be seen with the Portuguese situation of the time, due to the importance of the special schools of engineering and the military schools in Spanish mathematics, with the University gaining in importance at the end of the 19th century, and in particular in its last decade becoming the main institution for mathematics teaching and research in Spain. García Camarero emphasizes the importance of the *Escuela de Engenieros de Caminos* ("School for Road Engineers"), founded in 1802 and restructured in 1834, as possibly the school in Spain that in the first half of the century taught the most advanced mathematics. Rey Pastor in the above-mentioned lecture says that by 1840 Lacroix and Monge were taught in this school through Spanish translations of their works.

The first Spanish journal of mathematics and physics, *Periodico Mensual de Ciencias Matemáticas y Físicas* ("Monthly Journal of Mathematical and Physical Sciences"), was founded in 1848 in Cádiz by José Sanchez Cerquero, a retired Navy brigadier and at one time director of the Astronomical Observatory of San Fernando. This journal is analyzed in Ausejo and Hormigón [1986], in which there is no hint of any Portuguese connection, as there is no mention of Portuguese authors writing in the journal or of Portuguese subscribers.[90] Only six issues of this journal were published. This was due to the lack of success in increasing the number of subscribers and also to the lack of institutional support. This would be a recurring problem for other Spanish mathematical periodicals, and was also the case of *El Progreso Matemático*.

Ausejo and Hormigon were the editors of the Proceedings of a 1991 International Symposium on Mathematical Journals, published in 1993 as *Messengers of Mathematics: European Mathematical Journals (1800–1946)*. These proceedings include several papers on the Spanish situation and on some Spanish mathematics journals, but no analysis of the Academy's publications. However a few connections and similarities with Portugal can be seen in them. Hormigón mentions that at the end of the 19th century, when *El Progreso Matemático* was founded, as in Portugal, the mathematical community in Spain was still small:

> [...] mainly constituted of a small number of University and Institute lecturers, civil and military engineers, and some highly trained civil servants working in the state's administration departments.[91]

Hormigón [1993b] contains an analysis of the work of García de Galdeano and the first Spanish mathematical journal. Hormigón wrote other papers on this subject, in particular [1981]. Similarly to what happened in relation to Teixeira's journal, an international network of mathematicians collaborated with Galdeano. As Hormigón mentions in [1993b, 109–110], in the editorial of volume III of *El Progreso Matemático*, titled *A nuestros lectores* ("To our readers"), Galdeano says that the journal's aim had been achieved, as it had not only managed to mobilize the Spanish community of mathematicians but had also formed a network of foreign correspondents. Among these foreign mathematicians three Portuguese are named: Gomes Teixeira, Rodolfo Guimarães, and Schiappa Monteiro. Again similarly to Teixeira's journal, an important feature of *El Progreso Matemático* was its bibliographical section, which included reviews written by Galdeano of the then current publications. Thanks to him, Spanish mathematicians became aware of the works of Darboux, Peano, Veronese, Battaglini, Borel, Alexandrov, and many others [Hormigón, 1981, 88]. There were extended mentions in the journal of some foreign mathematical journals of the time. Among these was the *Jornal de Sciencias Mathematicas e Astronomicas* [Hormigón, 1981, 106].

The last part of Ortiz [1996] presents an analysis of Iberian mathematics in the last two decades of the 19th century and the early 20th century, up to World War I. By the beginning of this period, an increasing demand was being felt for qualified specialists in the professional schools. In response to this all over Europe journals were created which

[89] García Camarero considers four periods: 1800–1833, 1833–1856, 1857–1868, and 1868–1900, which does not essentially differ from Rey Pastor, who, as we saw above, implicitly considers three periods: 1800–1845, 1845–1865, and 1865–1900.

[90] The journal had 28 subscribers, living in 9 Spanish towns, the majority (13) being in Cádiz and Madrid. It had a reasonably wide distribution, being sold in 22 towns in the Iberian Peninsula, and also in La Havana and Santa Cruz de Tenerife and in Mexico [Ausejo and Hormigón, 1986, 37].

[91] "Formada principalmente por un reducido número de profesores de universidad y de instituto, por ingenieros civiles y militares y por algunos facultativos de determinados cuerpos de la administratión del estado" [Hormigón, 1993a, XV].

aimed to prepare students for the exams in these schools. They were called "intermediate" journals. In the peripheral countries it was thought that the resulting better trained specialists could help to break the country's dependence on the more advanced European countries. The structure of these journals was fairly uniform. In each issue there would be a list of proposed problems, and the best answers among the correct ones sent in by the readers would be published in later issues of the journal. It would also include a "Correspondence" section as well as a useful "Book Reviews" section, where books relevant to the readers (like textbooks on intermediate mathematics) would be analyzed.

Although the *Jornal de Sciencias Mathematicas e Astronomicas* was not an intermediate journal, in its first year of publication it regularly included a section for the diffusion of mathematics, from issue three onwards with problems proposed, and the best solutions to these problems sent in by readers would be published in later issues of the journal. Ortiz notes that the first Iberian intermediate journal is the Portuguese *Jornal de Mathematica Elementar*, which first appeared in manuscript form in 1883, while the first intermediate journal printed in the Iberian world was *Revista de Matemáticas Elementales*, published in Buenos Aires in 1889, followed in 1891 by *El Progreso Matematico*.

Two other papers in *Messengers of Mathematics* concern 19th-century Spanish mathematics: Velamazan [1993] and Llombart [1993]. Both deal with specific journals.

The first analyzes the *Memorial de Ingenieros del Ejército* ("Journal of Army Engineers"), a military and scientific journal founded in 1846 by General António Remón Zarco del Valle,[92] and published by the Spanish Army Engineering Corps. Mathematics played an important part in the training of military engineers, both in Spain and in Portugal. However, this importance is not reflected in the *Memorial*, of whose papers only 3% are on mathematics. Of these, half are on mathematical instruments, such as the arithmometer and planigraph. There is no mention of Portuguese collaboration in this journal, in fact it has no foreign input except for a translation of a Russian paper. The *Memorial* did not contain any new mathematics: essentially it aimed to transmit to engineers what was considered useful mathematical knowledge, mainly on practical ways to deal with mathematical instruments.

Llombart [1993] deals with the Barcelona journal *Crónica Científica* ("Scientific Chronicle") [from 1878 to 1892], founded by the engineer Rafael Roig y Torres. This journal defended the rights of Spanish teachers and aimed also to help to end the backwardness of Spanish science in relation to the advanced European countries. Llombart surviews the mathematical papers in the journal, counting 70 papers by 19 Spanish authors and 14 papers by 12 foreign authors. There were no Portuguese in this second group.

It seems that although mathematics in Spain and Portugal had similar general paths in some ways (but with different specific developments, as is emphasized in Ortiz [1996]), there were no significant exchanges between the two national communities of mathematicians except in the last quarter of the 19th century. In bringing about this change Gomes Teixeira, García de Galdeano, and their journals played a decisive role, not the Lisbon nor the Madrid Academies of Sciences.

4. Concluding remarks

Adrien Balbi (1782–1848), an Italian geographer and statistician who spent 20 months in Portugal during 1820 and 1821 and analyzed the Portuguese situation carefully, wrote the following in his essay on Portugal:

> Que seraient les nations anglaise, allemande, française, si leurs gouvernements defendaient la lecture des gazettes, des journaux et d'autres ouvrages périodiques; si une terrible inquisition veuillait continuellement pour empêcher la lecture des auteurs plus profonds dans l'art de penser et dans les branches les plus importantes des connaissances humaines; si une police aussi severe qu'ignorante signalait au souverain et à ses ministres comme suspects tous les hommes instruits qui voyagent pour augmenter leurs connaissances? [Balbi, 1822, 2, XXI]

This shows that it is important to bear in mind the specific historical circumstances of our subject of study. So the conclusions below on the mathematical contents of the *Memoirs* of the Lisbon Academy of Science in the 19th century do not conflict with our recognition of its crucial importance in the Portuguese scientific context. In particular for more than a half century it was the only journal in Portugal in which Portuguese mathematicians could publish the results of their research.

[92] Two years later del Valle became the first president of the Royal Academy of Exact, Physical and Natural Sciences (1848–1866).

We have seen that the *Memoirs* reflected the general weakness and small size of the Portuguese mathematical community during a significant part of the 19th century, with very few papers published annually, and very few Portuguese mathematicians working in areas related to the important mathematical questions of the day. Also, we see no continuity in their published work: very few published more than one paper. The lack of continuity is underlined by the fact that only one mathematician, Mateus Valente do Couto, and one general historian, Costa de Macedo, wrote in both the first and second series, and likewise only one researcher, Daniel Augusto da Silva, wrote papers in both the second series and the new series. In the period 1797–1903, 56 papers on mathematics were included in the *Memoirs*, written by 23 authors. Only eight of these published three or more papers in the Academy's journal: Mateus Valente do Couto, Filipe Folque, Garção Stockler, Daniel da Silva, Simões Margiochi, Monteiro da Rocha, Ribeiro dos Santos, and Ponte Horta.[93] Contacts with the international community were few and far between until the last quarter of the 19th century (although it is important to note that they were not completely nonexistent, and, as we have pointed out above, there was awareness of the new mathematics produced in Europe), with only three non-Portuguese mathematicians publishing papers in the first century of the Academy's *Memoirs*. We saw in one significant example that the yearly research program established by the Academy did not lead to corresponding published papers by its own academicians.

In a general overview of all scientific sections, we can see that as for the participation of foreign researchers, there was no long-term strategy to integrate the Academy's *Memoirs* into the network of the international community of scientists. In the long period 1797–1903 we have only 16 papers that are not written in Portuguese. This gives about one paper every seven years. Nine of these papers were published in the first series, between 1797 and 1820, and the other seven in the new series, between 1857 and 1903, while there was none in the long 36-year period 1821–1856. We saw that not only did few non-Portuguese researchers publish papers in the *Memoirs*, but also there was no continuity, and no concentration on any particular subject.

In the second half of the 19th century, and in sharp contrast to the general situation of a clear increase in Portugal of mathematical publications, and in particular of papers published in journals, there was a marked decrease in mathematical papers in the Academy's *Memoirs*. This can be explained not only by the appearance of other Academy journals that became alternative possibilities for mathematicians to publish their results, but also, and most importantly, by the founding in 1877 of Gomes Teixeira's journal, which became the leading Portuguese research journal in mathematics, a sign of the decrease in scientific importance of the Lisbon Academy of Sciences. It is significant that Gomes Teixeira, who represents such a qualitative change in Portuguese mathematics, and who had such an impact on the Portuguese mathematical community by making it possible for its members to be active participants in the international network of mathematicians, did not publish any mathematical papers in the Academy's *Memoirs*.[94] This may be a clear indication of the loss of mathematical weight and significance of the *Memoirs* in the second half of the 19th century.

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[93] Dantas Pereira wrote four papers in the *Memoirs*, but he is not included in this group, as only two are on mathematics.

[94] It is worth pointing out that Gomes Teixeira published three mathematical papers in the Academy's *Jornal de Sciencias Mathematicas, Physicas e Naturaes*: *Applicação das fracções continuas à determinação das raizes das equações* ("Use of continuous fractions to compute the roots of equations") in issue XIV, in 1872, published while he still was a student (in the *Memoirs* it is stated under his name: "Mathematics Student of the University of Coimbra"); and *Generalisação da serie de Lagrange* ("Generalization of Lagrange's series") in issue XX, 1876, which he rewrote and extended (with the same title) in issue XXVIII, 1880, as he had discovered an error in his earlier paper. In fact the only paper by Gomes Teixeira to appear in the *Memoirs* of the Academy is the *Historical Eulogy of Daniel Augusto da Silva*, published in Tome VIII in 1920.

References

Agudo, F.R.D., 1986. Contribuição da Academia das Ciências de Lisboa para o desenvolvimento da ciência. In: Vasconcellos Marques, A., Peixoto, J. (Eds.), História e Desenvolvimento da Ciência em Portugal, Volume II. Academia das Ciências, Lisbon, pp. 1301–1340.

Albuquerque, L., 1990. O ensino da matemática na reforma Pombalina. In: Ferraz, M., Rodrigues, J.F., Saraiva, L. (Eds.), Anastácio da Cunha (1747–1787), o Matemático e o Poeta. Imprensa Nacional/Casa da Moeda, Lisbon, pp. 19–25.

Anon., 1852. Collecção Official da Legislação Portugueza, Anno de 1851. Imprensa Nacional, Lisbon.

Anon., 1853. Collecção Official da Legislação Portugueza, Anno de 1852. Imprensa Nacional, Lisbon.

Ausejo, E., Hormigón, M., 1986. Noticia del periodico mensual de ciencias matemáticas y físicas (Cádiz, 1848). In: Actas del III Congreso de la Sociedad de Historia de las Ciencias, Volume II. Fotocopias S.L., Zaragoza, pp. 35–49.

Ausejo, E., Hormigón, M. (Eds.), 1993. Messengers of Mathematics: European Mathematical Journals (1800–1946). Siglo XXI de España Editores, Madrid.

Balbi, A., 1822. Essai statistique sur le Royaume de Portugal et d'Algarve, comparé aux autres états de l'Europe, et suivi d'un coup d'oeuil sur l'état actuel des sciences, des lettres et des beaux-arts parmi les portugais des deux hémisphères. chez Rey et Gravier, Libraires, Paris.

Carvalho e Silva, J., 2000. José Anastácio da Cunha: uma tragédia eterna. Educação Matemática 60, 15–20.

da Silva, I.F., 1858–1870. Diccionario Bibliographico Portuguez, Volumes I–XIX. Imprensa Nacional, Lisbon. Continued by B. Aranha in Volumes XX–XXII, 1883–1923.

Ferraz, M., Rodrigues, J.F., Saraiva, L. (Eds.), 1990. Proceedings of the Coloque Anastásio da Cunha 1744/1787. O matematico e o poeta. Imprensa Nacional/Casa da Moeda, Lisbon.

García Camarero, E., 1984. La matemática en la España del siglo XIX. In: Actas del II Congreso de la Sociedad Española de Historia de las Ciencias, Volume II. Gráficos Navarro, Zaragoza, pp. 115–130.

Gomes Teixeira, F., 1934. História das Matemáticas em Portugal. Academia das Ciências, Lisbon.

Grattan-Guinness, I., 1990. Convolutions in French Mathematics 1800–1840, 3 volumes. Birkhäuser Verlag, Berlin.

Guimarães, R., 1900. Les Mathématiques en Portugal au XIXème Siècle. Imprimerie de l'Université, Coimbra.

Guimarães, R., 1909. Les Mathématiques en Portugal. Imprimerie de l'Université, Coimbra.

Halsted, G.B., 1908. Biographical sketch of Paul Barbarin. The American Mathematical Monthly XV, 195–196.

Hormigón, M., 1981. El Progreso Matematico (1891–1900), Un estudio sobre la primera revista matemática española. LLUL 4, 87–115.

Hormigón, M., 1993a. Alguna prensa no es mentirosa: A proposito de las revistas matemáticas. In: Ausejo and Hormigón [1993, VII–XXIV].

Hormigón, M., 1993b. Garcia de Galdeano and "El Progreso Matemático". In: Ausejo and Hormigón [1993, 95–115].

Lisbon Academy of Sciences, 1780. Plano de Estatutos, em que convierão os primeiros socios da Academia das Sciencias de Lisboa, com beneplacito de Sua Magestade. Regia Officina Typografica, Lisbon.

Llombart, J., 1993. Cronica Cientifica: The articles of the mathematics section. In: Ausejo and Hormigón [1993, 267–281].

Morato, F.M.T.d'A., 1822. Collecção Systematica das Leis e Estatutos, por que se tem governado a Academia Real das Sciencias de Lisboa, desde o seu estabelecimento até ao tempo presente. Typografia da mesma Academia, Lisbon.

Ortiz, E., 1996. The nineteenth-century international mathematical community and its connection with those on the Iberian periphery. In: Goldstein, C., Gray, J., Ritter, J. (Eds.), L'Europe Mathematique-Mathematical Europe. Editions de la Maison des Sciences de l'Homme, Paris.

Queiró, J.F., 1992. José Anastácio da Cunha: um matemático a recordar, 200 anos depois. Matemática Universitária (Soc. Brasileira de Matemática) 14, 5–27.

Reis, F., 2007. Os Periódicos Portugueses de Emigração (1808–1822), As ciências e a transformação do país. Ph.D. Thesis. Lisbon New University, Faculty of Sciences and Technology.

Rey Pastor, J., 1915. Los Progresos de la Matemática en España y los Progresos de España en la Matemática, Discurso Inaugural. In: Congreso de Valladolid, Asociación Española para el Progreso de las Ciencias. Imprenta de Eduardo Arias, San Lorenzo, Madrid, pp. 1–19.

Rodrigues, A.J., 1811. Principes Mathematiques de Feu Joseph Anastase da Cunha, traduits litteralement du Portugais par J.M. d'Abreu, Moniteur Universel, August 8.

Rodrigues, J.F., 2004. Portuguese mathematical journals. Some aspects of (almost) periodical research publications. In: Saraiva, L., Leitão, H. (Eds.), The Practice of Mathematics in Portugal. Acta Universitatis Conimbrigensis, Coimbra, pp. 601–627.

Saraiva, L.M.R., 1993a. On the first history of Portuguese mathematics. Historia Mathematica 20 (4), 415–427.

Saraiva, L.M.R., 1993b. Rodolfo Guimarães e "Les Mathématiques en Portugal". In: Proceedings of the First Luso-Brazilian Meeting on the History of Mathematics. DMUC, Coimbra, pp. 37–57.

Saraiva, L.M.R., 2000. A survey of Portuguese mathematics in the XIXth century. Centaurus 42, 297–318.

Saraiva, L.M.R., 2005. O início da actividade científica de Francisco Gomes Teixeira (1851–1933). In: Proceedings of the 4th Luso-Brazilian Meeting on History of Mathematics. EDUFRN, Natal, pp. 161–176.

Saraiva, L.M.R., 2007. The beginnings of the Royal Military Academy of Rio de Janeiro. Revista Brasileira de Historia da Matemática 7 (13), 19–41.

Sørensen, H.K., 2006. Louis Olivier: A mathematician only known through his publications in *Crelle's Journal* during the 1820s. Centaurus 48, 201–231.

Velamazan, M.A., 1993. The Memorial de Ingenieros. In: Ausejo and Hormigón [1993, 259–266].

Walter, F., 1927. La litérature Portugaise en Angleterre a l'Epoque Romantique. Librairie Ancienne Honoré Champion, Paris.

Youschkevitch, A.P., 1973. J.A. da Cunha et les fondements de l'analyse infinitesimale. Revue d'Histoire des Sciences 26, 3–22.

Youschkevitch, A.P., 1978. C.F. Gauss et J.A. de Cunha. Revue d'Histoire des Sciences 31, 327–332.